SCHOOL SCIENCE AND MATHEMATICS

VOL. XLVIII — APRIL, 1948 — WHOLE NO. 420

# CHECK YOUR AMMETER?

## A High School Laboratory Experiment

JOSEPH A. MACK
*McBride High School, St. Louis, Missouri*

Enough controversy has raged around the need of, and what constitutes the "scientific attitude" and the "scientific method," highly desirable outcomes in all science education, without our adding fuel to the fire. Fundamental to all such outcomes to be cultivated in pupils is the attitude of accuracy, but only such accuracy as the instruments warrant. Another outcome in the teaching of science is the fostering in pupils the attitude of suspended judgment till sufficient data and evidence are available for valid generalizations or conclusions. Would it not be worthwhile in view of these attitudes to be cultivated to make determinations by several methods? For example, in a Specific Gravity of Liquids experiment, by (a) the displacement method, (b) the bottle method, (c) the hydrometer readings, (d) Hare's balancing columns method. So also in the Measurement of Electrical Resistance in Wires, by (a) Ohm's Law—voltmeter and ammeter readings, (b) Wheatstone's bridge determination, (c) ohmmeter reading.

The time factor in all high school laboratory experiments and the scheduling of these experiments usually preclude the use of several methods corroborative of a single result. Both teachers and pupils usually feel satisfied when the results of several trials concur within the limits of experimental error. When teachers demand a definite degree of accuracy in pupils' results, and the pupil finds by his several trials that such accuracy is not attainable by him, he is tempted to blame the measuring instrument for the error. Then the instrument must stand trial against known standards.

No teacher of physics would neglect to emphasize the fact that the silver coulometer is the standard for direct current measurements, and that ammeters are calibrated against this standard. But the silver coulometer is rather unpopular in high school laboratories for

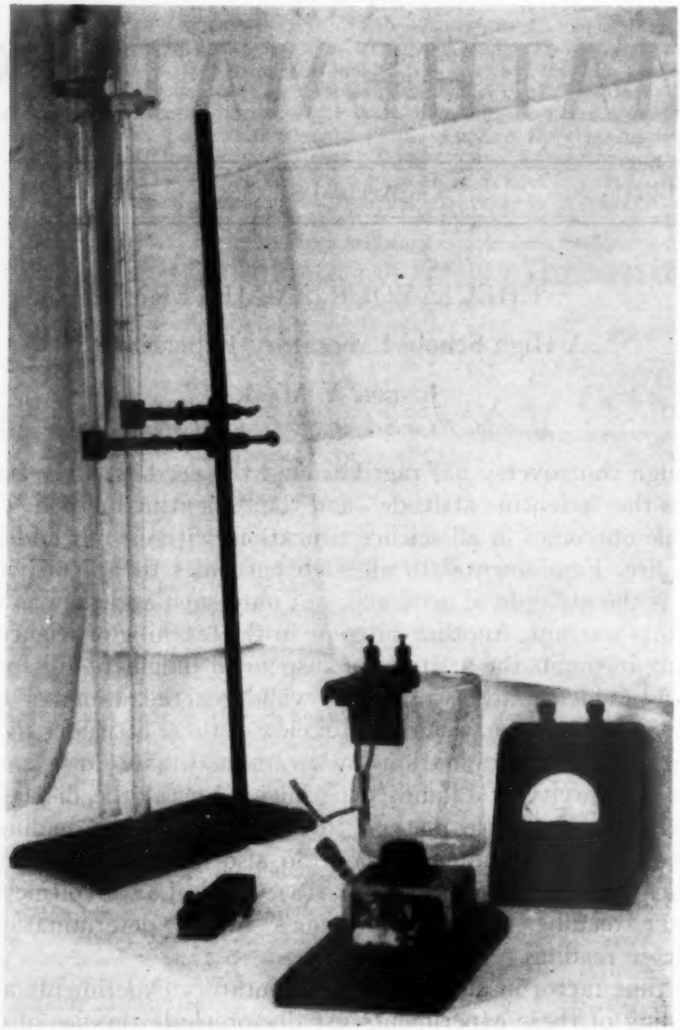


FIG. 1. The hydrogen and copper coulometers.

too many reasons. The electro-chemical equivalents, however, allow alternatives. Instead of the silver coulometer we could use a hydrogen coulometer, or a copper coulometer. Each of these has inherent difficulties, but not insuperable ones. Better yet would be the use of both methods to check the accuracy of student direct current ammeters.

The idea is not too far-fetched. It is advocated in the *Laboratory Experiments in Elementary Physics* by Newton Henry Black, (Macmillan), 1938. We heartily agree with the idea of checking student ammeters by both methods, but we diverge on the details of the procedures.

## A. The Hydrogen Coulometer

The apparatus can be simplified to a large extent over that illustrated in the above mentioned text. There is needed, (a) a container for the acidulated water, (b) a gas measuring tube, (c) a pair of platinum electrodes, (d) a variable rheostat, (e) a timing device, (f) a source of current, and (g) the d.c. ammeter. None of this equipment may be dispensed with, but we may substitute more rugged and cheaper equipment for the delicate and fragile ones of the text. Thus, the jar to hold the acidulated water is a 4×4 inch jar, such as is found in any laboratory, the kind used in previous experiments. For the electrodes we purchased an electrolysis apparatus consisting of a porcelain bracket, binding posts and two platinum electrodes, known to the trade as the Brownlee Electrolysis apparatus. For the gas collecting tube we use those found in all catalogues of the scientific supply houses. These houses will have their glass blowers seal a glass stopcock into the closed end of the gas collecting tube with no increase in volume. Such tubes then cost three dollars each. A burette clamp on a ringstand holds this tube over the hydrogen liberating electrode, the oxygen being wasted. Rubber tubing and a glass mouthpiece can be supplied from the stocks in the laboratory. Two tubes of different sizes are used, one of 50cc. for the trials at 0.5 and 1.0 amperes, and another of 100cc. for the 1.5 and 2.0 amperes. These tubes can be interchanged between student groups at different tables. The sizes recommended enable trials to be completed in five minutes. Using such long time periods and such large volumes of gas eliminates the need of accurate timing devices so that the school clock may be used. With a little care to allow the collected gas to come to room temperature very good results may be obtained. Tables will furnish conversion factors for the various temperatures and pressures.

This adaptation has *low cost* to recommend it, the total being below five dollars per set. The basic materials are readily *available* at most supply houses. The experiment is feasible in that the calculations are well within the average pupil's ability. The results obtained agree well with manufacturers' claims of 2% *accuracy* on their d.c. meters. Trials at the four intensities can easily be run during a double laboratory period. Some of the *difficulties* attendant to the experiment are that this procedure requires more acidulated water than is usually kept, something like three gallons for twelve sets. But then the solu-

tion is never consumed. The electrodes, thin sheets of platinum, are fragile. Current densities larger than two amperes were never tried because of the small area of the electrodes.

### B. The Copper Coulometer

The procedure here described is not new to the laboratory manuals. The acidulated copper sulphate solution used is stable, and while it may stain, the discoloration is not as bad as the one made by silver nitrate, especially to human skin.

The form of the apparatus recommended in the above mentioned laboratory manual is indeed delicate. But why need we invest in expensive and singular equipment when the available laboratory jars ($4\times 4$ inches or any other size) can be used, and the balances, accurate to 0.1 g. are adequate?

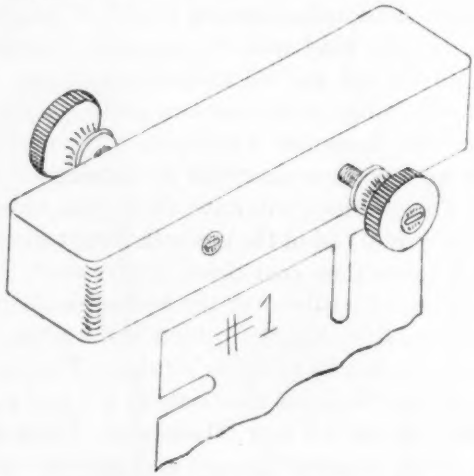



Fig. 2. An inexpensive plate holder for the copper coulometer.

We used the copper coulometer in its simplest form. The copper sheet is the kind used by metalsmiths for guttering, about a B & S #23. Our use of large plates, 100 $cm^2$ or more, eliminates the need of delicate balances. Into the opposite sides of a $1\times 1$ inch wood bar, long enough to extend over the top of the jars used, two 8–32 machine screws with brass knurled nuts on them are forced. These knurled nuts are to act as both holders of the copper sheets and as binding posts. A brass wood screw is used to support the other end of the electrodes. We use two notchings, about $2\times 15$ mm., in the copper plates for their suspension from the wood bar. These notches fit the wood screw and the machine screw, and allow the copper plate to be easily removed. The copper plates are stamped #1 and #2, and on alternate trials plating is done from 1 to 2, and vice versa. Using five

minute intervals for the trials, and current densities of 0.5, 1.0, 1.5, and 2.0 amperes (allowable current densities 10–15 amperes per sq. ft.)[1] similar to the trials on the hydrogen coulometer, we get similar reference points to check the d.c. ammeter.

The procedure is to plate for five minutes, timed by the school clock, rinse the gain plate in tap water, dip it in denatured alcohol and ignite. After weighing, the plate is immediately connected again for a second trial. During the time of this trial most students can finish the calculations.

Our claims for this modification are similar to those for A. The apparatus is *inexpensive*; the materials are readily *available* to most laboratories; the procedure is *feasible* to student ability; the results obtained are *accurate* and free from the aggravating experimental

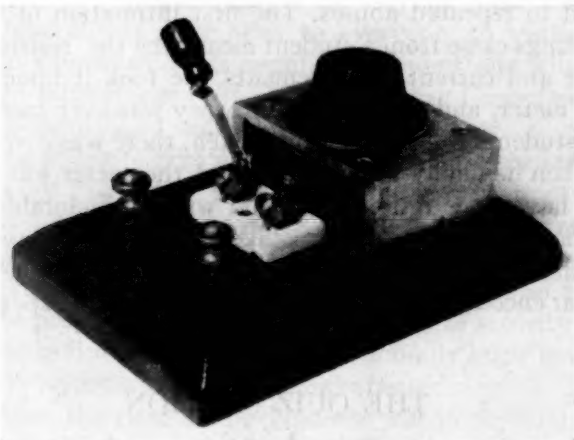


FIG. 3. The variable rheostat mounted.

errors found in more delicate apparatus. Results agree with manufacturers' claims of accuracy for their meters.

## THE VARIABLE RHEOSTAT

A word might here be added about the variable rheostat, a piece of apparatus which is needed in both methods. The parts are (a) a wood base, $4\times 6$ inches, (b) two metal binding posts, (c) a miniature knife switch, s.p.s.t., (d) a variable power rheostat, 25 w.–25 ohm, Centralab 48-025, (e) formed metal channel, $2\times 2\frac{1}{2}$ inches.

The base can be set on four rubber covered tacks for feet. Connecting wires can be recessed into the base and brought out through it to the knife switch and to the rheostat. The formed metal channel (we

[1] J. Rosslyn, *Electro-plating and Anodising*, Brooklyn: Chemical Publishing Co., Inc., 1941.

use an aluminum channel) covers the rheostat and is held against the base by four screws at its four corners. The rheostat is the kind used in radio work, 25w.-25 ohms, but different sizes may be used depending on the voltage and current supply. Through a hole drilled into the channel, the rheostat is held against the channel and away from the wood base. At times the rheostat will smoke, but so far we have had no failures. The labor involved in building a dozen of these pieces can be assigned to willing and capable students. The total cost is about two dollars each.

---

Accidents are prone to happen at the most inopportune times. During the last days of the war when replacements of equipment were difficult if not impossible, one of our direct current ammeters finally succumbed to repeated abuses. The first intimation of the meter's faulty readings came from a student measuring the resistance in wire by voltage and current measurements. He took it upon himself to check the meter, and no District Attorney was ever more impartial than this student. But by the same token, there was a very exultant student when he finally won his case and the meter was declared at fault. We have since retired the meter with an honorable discharge, which today we believe was a mistake. Would it not have been wise to retain this faulty meter and let other students, capable of profiting by a similar encounter, have the pleasure of such an experience?

---

## THE QUIZ SECTION

Julius Sumner Miller
*Dillard University, New Orleans 19, Louisiana*

1. A small body rests on the top of a smooth sphere. It is slightly displaced. Where does it leave the sphere? Assume it slides.
2. How far beyond the sphere does the body in #1 strike the horizontal plane on which the sphere stands?
3. If a thin homogeneous rod were stood vertically on end and allowed to fall over, with what angular speed would it strike the ground?
4. A solid cube rests on the flat horizontal floor of a truck. Examine the conditions for sliding or tipping over when the truck starts and stops.
5. How about this business of the coiled-up spring dissolved in acid?
6. Find a point on a vertical circle for which the time of descent along a radius to the center is the same as the time of descent along a chord to the lowest point of the circle.

---

The cause of education can not fail, unless all the laws which have hitherto governed the progress of society shall cease to operate, and Christianity shall prove to be a fable, and liberty a dream.

*Henry Barnard*

# THE CONTROL AND BENEFICIAL USE OF ATOMIC ENERGY*

SAMUEL K. ALLISON
*Director of Institute for Nuclear Studies, The University of Chicago*

I have not been directly associated with any work of the Atomic Energy Commission or any work on the Atomic Energy Program since January 1946. At that time I left Los Alamos and came back to the University of Chicago. The Iron Curtain of the Atomic Energy Commission descended behind me, and since that time I have not had any sources of information about what's going on that you have not had. That is, what has been made public I have read, and so presumably have most of you. I came back to the University because I like university life; I enjoy association with students; and I like to do research in a free and open manner, in the way we did before the war, when our laboratories were open to everyone, to visiting foreign scientists, to anyone who was qualified to understand what we were doing. In the laboratories of the Atomic Energy Commission, affairs are quite different. But I shall speak about that later.

I am going to try to give you some idea of what the status of the Atomic Energy Program is today as it appears to an outsider, who nevertheless is a somewhat informed outsider. But I am really rather grateful that the iron curtain has descended behind me because it makes it much easier to talk to you. The scientists who are still actively on the program are constantly in danger of security violations when they talk. But since I officially and actually know nothing since January 1, 1946, my situation is somewhat eased.

Shortly after the close of the Japanese war in September 1945, a committee of scientists actively engaged in the atomic bomb project was appointed to forecast what the future held in the way of applications of atomic energy, and what should be done. I was Secretary of that committee, and we drew up a report which was promptly stamped top secret and is reposing in somebody's file in Washington. I don't know where it is. But as far as I can see, the report in its main outline pretty accurately forecasts essentially what has happened. We all thought at that time that we were on the threshold of a new era in our dominance or mastery over the material universe which surrounds us. None of us expected that people would be running automobiles or airplanes, or lighting their houses with atomic power in the next few months. We tried to see without looking through rose-colored glasses just about what would happen, and we were all agreed that the first and obvious activity would be study by scientists, and application, by

* Presented at the Annual Meeting of the Central Association of Science and Mathematics Teachers, November 28, 1947.

technologists and medical men, of the radioactive substances which can be produced in the chain reactors. We were sure that this would happen because it wasn't entirely new. Up to the time when the chain reactions began, radioactive substances were made with the use of the cyclotron, and had already been tried and studied by many investigators, and used in many techniques. But the cyclotron, except in certain very special cases, cannot compete with the chain-reacting piles for the production of large amounts of these new substances. So we envisaged, in September 1945, that the first peace-time activity would be the manufacture and distribution of radioactive substances to medicine, industrial technology and to scientists. And this has come about. One of the things that pleased me most among the recent activities of the Atomic Energy Commission was the decision to distribute some of these new substances to anyone who is properly qualified, any place in the world.

If a medical man in India is associated with a reputable hospital and writes in to the Atomic Energy Commission for radioactive phosphorus, he can buy it and treat his patients. Now this seems to be an obvious thing, that if we have discovered or have available in this country methods of preparation of large amounts of valuable substances for the treatment of disease or for the advancement of science and technology, we should make these available to the whole world. At least it would have seemed obvious before the war. But even this step, the distribution of absolutely harmless radioactive substances met political opposition. But it has gone through. And it has increased the respect of scientists all over the world for the United States. And the dividend in good will that we will accumulate for having taken this step I think is a very decisive factor in showing that the step was a good one.

Now what are some of these substances? I will tell you about a few of them. There are 450 or so new forms of existing elements or isotopes of new elements which can be made in the chain-reacting piles in relatively large quantities. Obviously I cannot begin to discuss 450 substances. I'll just say a few things that I think are of special interest. Of course, plutonium itself, which is the active element in one form of the atomic bomb, is one such substance. It is a new element, not found in nature, which is produced in the chain-reacting piles. However, it is not one of the substances which the Atomic Energy Commission is distributing. This we certainly cannot blame them for. At the present state of the world it would be a very bad thing—it certainly would be reprehensible—to let plutonium get into irresponsible hands. It is not an innocuous substance, and of course it is not being distributed. In fact, practically every atom of plutonium is carefully tabulated by the Atomic Energy Commission. The other

substances, however, of scientific interest which can be produced are new nuclei, or nuclei which we have not previously had opportunities to study. In order to find an atomic species in the earth it must have a life comparable to the life of the earth. That is, suppose that an elementary substance might have been formed at the time of the formation of the earth, which we know little about. Let's suppose that it only lived a hundred million years. It would have disappeared practically at the present time. Now, all the elements that we find in the earth's surface must have at least one isotope which is long-lived compared to the history of the earth. And that's the reason that we do not find some of the elements. For example, the element of atomic number 43 apparently does not exist on our earth, and now we know the reason, namely, that there is no isotope of that element which has a life comparable to the life of the solar system. So it has died out. Now 43 can be reconstructed with the aid of the chain-reacting pile. That is, you can add a neutron or a unit of atomic weight to the appropriate isotope of molybdenum which is element #42 and eventually you get a transient form of element 43; transient meaning it may live a few hundred years or so, which is long enough for you to study it. And so grams of element 43 have been prepared, and qualified chemists are having the fun of investigating a totally new element. The excitement of the chemist over this prospect is about the same as that of a zoologist who might see a pterodactyl fly into his laboratory and submit itself for dissection. The Atomic Energy Commission is presenting to the chemist an extinct element, just as the pterodactyl is an extinct animal, and is allowing it to be studied. Well, there are several of those. There is element #43 and element #61, which also apparently has no isotope whose life is comparable to that of the solar system so that it has not been available for study. In fact, we now have available for study practically every element from #1 up to 95 in either a stable or transient form. Elements #85 and 87 cannot be made with the chain-reacting piles due to peculiarities which I won't discuss at present, but they are being made in minute amounts by means of cyclotrons.

These elements are of great scientific interest. I think it is somewhat doubtful that they will be of practical importance. After all, although they can be made and distributed they are quite expensive. Since they fit in Mendeleff's periodic system, usually a less expensive element can be found which will do technically and commercially what the new substance will do. For instance, element 85 belongs to the halogens and had received the name of astidine to rhyme with iodine, chlorine, fluorine, and bromone, and is an element of that type. It's extremely interesting of course chemically but it is doubtful to me whether it will receive widespread industrial or technological

application. Now those things are of interest mainly to the scientist—the pure scientist—who just likes to play with some extinct element and see what its properties were or are today in its reconstructed form. And those things, as I say, can be made and are being made, and are being distributed from the chain reactors. Now there are radium substitutes also, which can be made, and these certainly will have widespread technological and medical application. One substance which is rather outstanding in this respect at the present time is a form of cobalt, cobalt of atomic weight 60. Cobalt of atomic weight 59 is the normal form of cobalt as we find it in the earth's surface. We can add a neutron to this in the chain reactors and form cobalt of atomic weight 60. This is a transient form for cobalt which lives about five years. It emits quite a penetrating gamma ray, of about 1,000,000 electron volts energy equivalent, which means that it is not as penetrating a gamma ray as we get from natural radium. Unfortunately at the present time, at least to me, there is not known any pile-prepared substance which lives longer than 15 days which has a gamma ray as penetrating as radium. You can make very transient forms of some elements which have gamma rays much more penetrating than radium but what's the use? If they live only 15 days the transportation time for technological application gets just too inconvenient. So if you limit yourself to things that live long enough to have some use you begin to look at things like this cobalt which has a five year life. You can make cobalt intensely radioactive by exposing it in the chain reactors and you can ship it around to hospitals and do radiography with it. Suppose that your ship or your airplane breaks down in the antarctic and you want to know where the break is in a casting somewhere, in the motor, or the drive shaft. You can fly out a little bit of cobalt 60, and a little pinpoint of it is so intensely radioactive that you can take a photograph right there and can detect where the machine is broken down. There is a form of antimony which has atomic weight 124 which gives an even more penetrating gamma radiation than the cobalt. Gamma radiation from the antimony is more comparable to that of radium, and it lives 60 days and can be transported and used. The stuff can always be generated. It isn't as serious to lose a specimen of radioactive antimony or radioactive cobalt as it is to lose some of your precious radium, because you can always make more. Now those are what we might call gamma ray sources which are being made and distributed. There are many others, for special purposes.

Another class of substances which are being made available are called inorganic radio-isotopes. Almost every element in the periodic system can now be made in radioactive form. The best known of these substances at present is radio-phosphorus, the 15 day form of

phosphorus which can be made easily in large amounts, and distributed for various purposes. I will not enlarge now upon this point of the inorganic radio isotopes because they are such a mass of material it doesn't pay to go into detail. A few days ago, I was talking to a research chemist of a large glass company. The company is interested in these inorganic isotopes because they would like to label their glass. This company is afraid that some of its special brands of optical glass or good glass are being bought up and pirated and issued by other manufacturers, just changing the etchmark on the glass to a different name. Well, they can stop that if they want to. If they want to put a little radioactive material into their glass when they make it they can go around with a Geiger counter and claim their glass wherever it may show up. Because it will be perfectly definitely labeled, as to its origin. Well, that's one of many many things that are becoming possible.

Now, another class of substances perhaps of even more vital importance to us are called organic radioactive substances. One of the very fortunate things about the use of the chain-reacting piles is that they permit the preparation of the element carbon in radioactive form in large amounts, and in a form which lives for a long time—some 5,000 years. Now we knew a radioactive form of carbon before the chain-reactors started; in fact I remember in 1935 when I was working in the Cavendish Laboratory in England I did a little piece of research on the carbon of atomic weight 11, which is intensely radioactive and lives about 20 minutes, which of course is unfortunately short. Because of the great importance of a radioactive form of carbon even when this was the only form known, the biological and medical people started to work with it, hurrying up their experiments, devising quick chemical reactions so they they could do something with it before it died. At the University of Chicago for instance, Dr. Evans investigated the ability of certain tissues in the body to absorb $CO_2$ by this method. And people investigated the rapidity with which plants absorb $CO_2$ from the atmosphere. By feeding the plants radioactive $CO_2$ you can see how quickly the carbon dioxide is taken up into the plant structure. But now with the piles we have a much more valuable form of carbon, mainly the isotope of atomic weight 14, the famous carbon 14 which lives several thousand years. The Atomic Energy Commission is making carbon 14 and is distributing it all over the world. The point is, you see, that carbon as you all know is the life element. I mean every part of our body contains carbon. All the organic materials contain carbon, and now we can make medical preparations and drugs which are radioactive. Even more than that we can make radioactive plants and animals. In fact, there is talk, and the talk has pro-

ceeded to a stage where there will soon be action, of having a radioactive farm, on which radioactive horses and mice and cats and plants will be raised. The point of this is that for some drugs and medical preparations the only synthesizer we know is the animal itself. That is, if you want to make tetanus vaccine the only way you can do it is to give a horse tetanus in mild form and extract the antibodies from his blood. Now if the horse is radioactive, the antibody to the tetanus poison will also be radioactive and we can have radioactive serums of that kind. We can experiment with them and eventually put the serums in a human being (certainly not at first until its technique has been proved safe on animals) to find just where they go in the body quickly, as for example, to the liver. At least one can find out to what organ in the body the substance goes, at once, without the delay of chemical analysis of a very vaguely and indefinitely known and complex organic substance. Now, radioactive methyl alcohol has already been made from this radio carbon, and is being distributed. This is a recent development which was published just about six weeks ago. Up to that time radioactive carbon had only been distributed as radioactive carbon dioxide or, worse than that, as radioactive barium carbonate, and that is a very tough substance to start with to synthesize any interesting organic chemicals. If all you have to start with is barium carbonate and you want to build up for instance radioactive aspirin to see what it does, you've got a long, tough job to go through. It can be done, but it slows down things tremendously to have to start from such a simple inorganic as barium carbonate. But now, if you are a qualified person, you can buy radioactive methyl alcohol which is already in somewhat complex organic form, and synthesis of more interesting drugs is relatively easy. I don't envy the Atomic Energy Commission its job in trying to decide who shall obtain these things, because lots of quacks and charlatans are going to apply to the commission for substances and then advertise that they can cure in-growing toe nails and various other fancy ailments with these things. Unless this traffic is very carefully watched there can be wide-spread abuse of the new techniques. But radio-carbon properly used may have the greatest effect on our lives of any of these new substances because it will open wide the field of biochemistry as it hasn't been opened before. Well, those are some of the things that have been distributed already.

Now I would like to say a little bit about atomic power. Actually the Atomic Energy Program will never blossom out into anything of major size unless there is such a thing as atomic power; unless electricity, to be concrete, is made from atomic energy, and used in our cities and throughout our civilization. You can make all the radio isotopes that I have talked about to satisfy the demands of the world

in a few chain-reactors, maybe even one large energy chain-reactor, and saturate the demand. But if the Atomic Energy Program is ever going to get off the ground floor and take flight it will have to be because there is a widespread utilization of power from uranium. The problems are largely technological in nature. The power is there. One of the most accurate things we know about the whole program is exactly how much power is there. It seems to be one of the constants that is easy to determine. How to get it out is a different matter. The problems strangely enough are quite similar to many of those that one meets in the construction of jet engines for airplanes. The problem is the finding of metals, alloys, or ceramics which can be built into machines which operate at high temperatures. You see, the tragic point, the Achille's heel I might say, of the Atomic Energy Program is that we have this fantastic and completely modern 20th century source of power in the splitting up of uranium atoms, but in order to utilize this power we have to chain it to the 18th century Carnot cycle. The only way that we know how to use this power at the present time is to heat up some fluid or gas and to extract the heat from that and convert the heat into mechanical energy. So at present we are thinking of using atomic power just in the way that you use coal, that is you heat up water, make steam out of it and make the steam work. The only place the atomic energy fits in is to replace the coal. But fundamentally the energy is available in electrical form in the kinetic energy of these fragments of the uranium atom flying apart. Putting that beautiful and highly efficient source of energy through the Carnot cycle is a disgrace. You degrade it to heat and, waste most of it before you can convert it back into mechanical energy. If that obstacle can ever be gotten around it would be an entirely new era of atomic power. Nobody even thinks that obstacle can be surmounted at the present time. Nobody knows how to do it, so we are thinking now of using the essential principles of the steam engine for atomic power. You all know that the steam engine gets more and more efficient as the working temperature increases, so in a desperate attempt not to shame ourselves by wasting 60 or 90% of our atomic power, we're trying to get the temperatures higher and higher at which the thermal energy is turned into mechanical energy, because then we get greater and greater efficiency. Actually there is no limit to the temperature at which we could use the power from splitting uranium if we had any materials which would stand it. You know that the temperature of the atomic bomb as it explodes is about one hundred million degrees centigrade. That's very nearly like the interior of the sun, but there is no known material, of course, which will even approximate standing up or containing a gas or being useful at such temperatures. So as I say we are trying to force a tremendous

new source of energy through the knot hole of the old fashioned Carnot cycle, and I'm afraid that is the first kind of atomic power that we will see. The Atomic Energy Commission is reputedly working hard, and I have no reason to believe they are not doing so, trying to develop more and more efficient ways of using the Carnot cycle to extract power from uranium. We recently heard the news that the first chain-reactor in England has started. It is a small affair, not suitable for the production of power, but the English have to learn from the beginning the way we did because it has been decided that we will not share any information with them. But they of course are interested in atomic power because of their coal shortage. It may be the method of rebirth of the industrial life of England.

It was advertised to you that I was going to speak about the control of atomic power and I find of course that I have maybe three or four minutes to do so before we must adjourn. This problem is a very tough one, and at the present time it looks very black. There is hardly a cheerful note to be heard. Now it is an extraordinarily difficult situation because of its complexity. It is not essentially a new situation. Let me remind you that wars previous to this one and the next one were fought mainly with organic chemicals; that is, trinitrotoluene and other high explosives are essentially organic chemicals. Now would anybody suggest that we should suppress and discontinue the science of organic chemistry because organic chemicals are vital to carrying on a war? We are in that trouble right now. You see, everyone of us has agreed that Germany shall never rise again and be a menace to the peace of Europe—rise in the military sense. In order to insure that she shall not do this we are dismantling any factories or facilities which in our judgment may make Germany again a military power. What happened? The fertilizer plants came down. You see, fertilizers are organic chemicals, very similar to high explosives. They are made in the same plant. You practically turn a stop cock and the high explosive comes out here and the fertilizer comes out there. So you tear down the fertilizer plants. By all means let us do so. Then we find the country starving because the fields cannot be fertilized. The economic level sinks and in desperation the people may turn to a totalitarian form of government. Now you see the impossibility of disconnecting the different phases of our extremely complex industrial and technological civilization. It is the same problem with atomic power. It is true that large plants producing atomic power could be seized by a nation in time of war, rapidly converted into plants where plutonium and atomic bombs could be made. I don't see any sound way around it. Are you going to stop the utilization of this form of energy because of the danger? The thing is just inherently so intermingled, the peaceful and warlike

properties of the thing are so closely allied that they can hardly possibly be disentangled. Now, a lot of people in this country are shouting keep the secret. Well, one has a certain amount of sympathy with them. But they reckon not what they do, because they may do more harm to us than good. Although this is a controversial point, everybody having his own violent opinion about it, my opinion is, as I said in September 1945, that the real "secret" of the atomic bomb is actually the huge industrial potential of the United States. That is, the scientific aspects of how to make one are well known all over the world. Mr. Molotov didn't add anything to the discussion when he said a month ago that there was no longer any secret to the atomic bomb. People like myself and other scientists have been saying so a long time. But the point is, to make one is a tremendous industrial and technological effort. The United States succeeded because in all industrial facilities of the country the atomic bomb was given the highest priority. It is my opinion that we ought to go as easy on security and secrecy as possible. No reputable scientist, and I consider myself one, has ever suggested that we should take the blueprints of an atomic bomb and give it to Mr. Stalin. There is no use. I mean it is just like handing anybody a revolver. The atomic bomb itself can be used for nothing except evil purposes and neither should we give up blueprints of plants which are designed for the manufacture of the bomb. Or give out statements of how many bombs we have or what our production schedule is. Nobody advocates that. But let me give you an illustration to show how far the pendulum has swung in the wrong way. We are building at the University of Chicago a very large cyclotron which is a non-classified project, it's open to everyone, there is nothing secret about it. We need some very big high-vacuum pumps, some of which are now war surplus. We would like to get these pumps for our cyclotron. But at the present time the Atomic Energy Commission insists that part of that pump is classified as secret. And if we install the pump in our University laboratory we will have to have an armed guard there watching that pump, and we must have a barbed wire enclosure around that pump because there is an internal part in that pump which was developed by scientists on the Manhattan project.

The hysteria about classification and secrecy has really gone too far in my opinion. I believe that we are hurting ourselves by inhibiting technological advance of this new subject. You can't have technological advance in a subject which you cannot discuss, and I believe that when you balance things out the safest procedure for us to adopt as a nation is to use secrecy as little as possible. All of us should take the attitude for goodness sake let us not make this secret unless it is really necessary. Let us have open discussion among

scientists and technologists of the possibilities, then, because we have this unparalled technological development and potential in this country, we can develop these ideas much more rapidly than any other country in the world. We can use new suggestions and new ideas as they arrive. The world is of course looking to us in this matter considerably. If we take this attitude, the rest of the world, in my opinion is very likely to take it. If we persist in our hysterical attitude of secrecy the rest of the world will too. We haven't any monopoly on brains in this country, and good ideas may spring up elsewhere. If we encourage the attitude that new ideas and discussion be as widespread as possible, we with our unequaled production and know-how can rapidly develop those ideas where ever they come from. I believe that the balance is in our favor in taking the attitude that secrecy should be kept to a minimum.

---

## MORE THOUGHTS ABOUT MARKS

Sol Whitman
*Senior High School, New Brunswick, N. J.*

I should like to comment briefly on the ideas expressed in "Girls and Grades" by Dean Lobaugh that appeared in the December, 1947, issue of School Science and Mathematics. There is no intention either to start or to enter into any controversy regarding the opinions so aptly expressed by the author. Indeed, I heartily agree with many of Dean Lobaugh's beliefs as stated in the above-mentioned article but I feel there is yet another viewpoint.

Much has been written recently regarding the fact that the marks received by girls are superior to those of boys despite the relatively inferior placement of girls on achievement tests. Studies made by various authorities reveal this fact to be indisputable. Explanations of the causes vary from the teachers' dislike of the odor of perspiration emanating from the boys returning from gym to the theory that girls are taught the rudiments of charm from birth.

I believe that the objectives of the school and, more specifically, the objectives of the various courses are the result of our best thinking and should, therefore, furnish the criteria for judging a student's mark. Tidy habits, for example, are goals of accomplishment equally important to both sexes. Although girls of high school age are naturally more apt to excel in their habits of neatness, an untidy paper from a girl should be worth exactly the same as an untidy paper from a boy. Where logical reasoning is one of the aims of the course, the students should be graded according to the discernible improvement. If boys are able either through conscious effort or because of their inherent nature to excel in this particular objective, then they should be given the proper recognition. The fulfillment of the aims and not the sex of a student should be the determining factor when deciding on grades. We should have no dual standards.

Discerning appraisal of a pupil's performance in class requires several grades, each manifesting the accomplishment of an aim. However, most teachers must grade each student with one mark. In order that the mark represent the composite picture adequately, all factors must be taken into consideration. If the girls fare better than the boys in the over-all picture, let us give them their due. Obviously it is wise to be alert in our recognition of the separate behavior patterns of boys and girls but we must guard against over-rationalization in dealing with boys and underestimation of our girls.

# THE PRESENTATION OF THE VAN SLYKE-NEILL MANOMETRIC TECHNIQUE TO THE SECOND YEAR COLLEGE CHEMISTRY CLASS

SHEILA O'TOOLE AND GEORGE E. F. BREWER
*Marygrove College, Detroit 21, Michigan*

## INTRODUCTION

A frequently observed shortcoming of the chemical instruction in colleges is the neglect to familiarize the students with the modern equipment and methods used in commercial and clinical laboratories. The presentation of these techniques in the form of an independent undergraduate course does not seem to be warranted, since the great variety of fields and principles involved may be confusing to the student if used in a single course. Furthermore, the theory of these analytical methods necessitates much overlapping with the essentials of other courses; and, finally, it is not intended to demonstrate that the possibilities to use instrumental techniques exist, but rather to make the student "instrumental minded."

It is customary to give instruction in the quantitative determination of carbon dioxide in inorganic carbonates by the use of the gravimetric method. The use of a gasanalytical method, however, would entail supervision in important techniques and the practical application of the ideal gas law.

## THEORY OF $CO_2$ DETERMINATION

Carbon dioxide in a carbonate may be determined in one of four fundamental ways:

Gravimetrically, by finding the loss in weight once the carbon dioxide has been removed; by precipitating the carbon dioxide as an insoluble carbonate; or by absorbing the carbon dioxide in a weighed bulb containing some solid alkali (e.g., ascarite) or alkaline solution.

Volumetrically, by titrating with standard acids and bases.

Gasometrically, by measuring the volume of carbon dioxide at barometric pressure immediately; or by freezing the carbon dioxide and measuring it later.

Manometrically, by measuring the pressure exerted by the carbon dioxide liberated in a chamber of constant volume.

By the use of a closed system, the Van Slyke-Neill manometric apparatus (8), (5), eliminates dependence upon the barometric pressure of the day,—reabsorption of the $CO_2$ gas and determination of the residual pressure achieves correction for water vapor tension, so that the ideal gas law can be applied directly.

The chemistry of this carbonate analysis is simple. The sample is introduced directly into the Van Slyke chamber, an acid added and the liberated carbon dioxide measured, making the reaction essentially:

$$CO_3^{--}+2H^+=CO_2+H_2O.$$

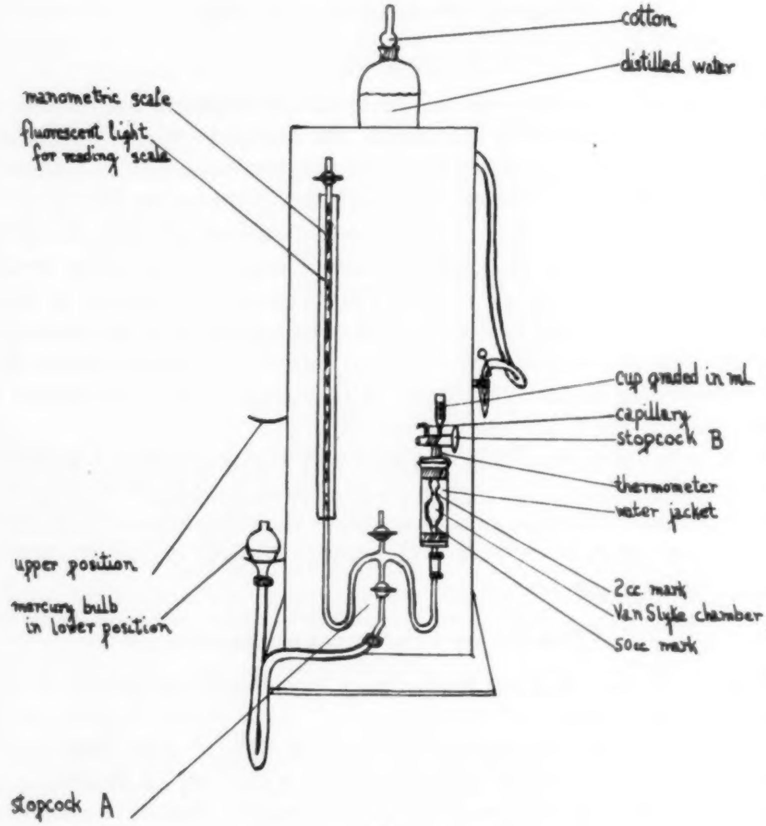



FIG. 1. Van Slyke-Neill Manometric Apparatus.

## EQUIPMENT

*Van Slyke-Neill manometric apparatus (See Fig. 1):*

A water jacket surrounding the reaction chamber of the apparatus serves to keep the gas at a uniform temperature and facilitates the temperature reading. The reaction chamber and manometer are interconnected with a mercury leveling bulb.

*100 ml. volumetric flask* for solution of sample.

*Van Slyke pipettes* equipped with rubber tips; 2 ml. for admitting sample to chamber (any pipette of suitable bore, and over 2 ml.

capacity, may be used here, provided it is equipped with the Van Slyke rubber tip). 1 ml. for admitting lactic acid to chamber.

*1 ml. graduated pipette* with rubber tip for NaOH, marked to show 0.5 ml.

### Reagents

*Sample:* Prepared by dissolving 0.20 g. unknown carbonate to 100 ml. with 25% NaCl solution (50 g. of NaCl to 150 cc. of water). 0.20 g. is a convenient size of sample for unknowns containing from 8% to 30% carbon dioxide.

Approximately *5 N NaOH*. Prepared by mixing 1 volume of the 18 to 20 N NaOH with 3 volumes of water.

Approximately *2 N lactic acid* in nearly saturated NaCl solution. 1 volume of concentrated lactic acid (sp. gr. 1.20) is diluted to 5 volumes with 25% NaCl solution (1).

*Acidified water*. 1 cc. conc. HCl in 200 cc. water.

Experience has shown that it is necessary to provide a description of all practical details if satisfactory results are expected of the beginner.

*Procedure:*

Make sure mercury bulb is at lower position on Van Slyke machine. About 1 cc. Hg should be in cup. Open stop cock A.

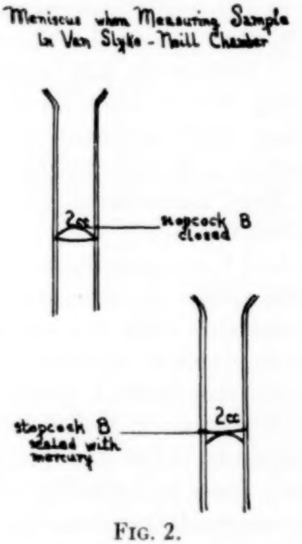



FIG. 2.

Pour out a small portion (about 5 cc.) of the sample solution into a clean beaker. Use it to rinse out the 2 ml. Van Slyke pipette and beaker. Discard this amount and pour another 5 cc. portion into beaker. Do

not measure these small samples. Fill the 2 ml. pipette with the solution and place its rubber tip firmly against bottom of cup. Examine cup. If pipette is in correct position, a circle of rubber can be seen where pipette meets glass cup. Keep pipette in this position and open pipette stop cock. If held correctly, solution should not leak into cup. Open stop cock B and allow solution to flow into chamber until mercury meniscus reaches lower foot of figure "2" at 2 cc. mark. Close stop cock B. Close pipette stop cock. Remove pipette from cup. Open stop cock B just long enough to let a drop or two of mercury flow into chamber. Close stop cock B. This provides a mercury seal at stop cock B. Mercury meniscus in chamber should now be exactly at 2 cc. line.

Fill the 1 ml. Van Slyke pipette with the lactic acid. Place its tip in cup so rubber ring is visible. Open stop cock on pipette. Open stop cock B and allow acid to flow into chamber until lower mark is reached on pipette. Close stop cock B. Close pipette stop cock and remove pipette. Seal with mercury as before by opening stop cock B until a drop of mercury falls into chamber and quickly closing it again. Turn stop cock B to let mercury go from tip of capillary to below elbow. Close stop cock B. Lower mercury bulb and slowly close stop cock A when mercury meniscus is at 50 cc. line. Secure leveling bulb in lower position. Remove mercury and other liquids from cup with dropper pipette.

Shake for 3 minutes at 325 oscillations per minute. Adjust chamber to vertical position. Open stop cock A. Allow liquid in chamber to rise swiftly, but without turbulence. Let liquid meniscus approach 2 cc. line slowly. Close stop cock A when liquid (bottom of meniscus) reaches this point. Using magnifier, read manometer to tenths of a millimeter. Lower mercury to 50 cc. line again. Shake for $1\frac{1}{2}$ minutes. Return to 2 cc. line. Read manometer again. These two readings should not vary more than 0.2 mm.

Open stop cock A. Add 1 cc. mercury to cup. Admit 0.5 ml. 5 N NaOH from pipette with rubber tip as before by opening stop cock B. Remove pipette and seal stop cock B with mercury. Fill cup with acidified water. Lower meniscus of liquid to slightly below 2 cc. line. Close stop cock A. Open stop cock A slowly until liquid meniscus reaches 2 cc. line. Close stop cock A. Read manometer. Open stop cock A. Lower liquid again to below 2 cc. mark. Return to 2 cc. line. Read manometer again. These two readings should check within 0.2 mm. Read temperature on small thermometer.

Open stop cock A. Raise mercury bulb to upper position on machine. Expel solution through capillary by opening stop cock B. Close stop cock B. Lower mercury bulb. Open stop cock B towards cup. Let all but a few drops of acidified water flow into chamber.

Close stop cock B. Fill cup with distilled water. Lower mercury in chamber to 50 cc. line. Adjust stop cock A so mercury rises slowly in chamber. When chamber is filled again, open stop cock A and raise mercury bulb to upper position. Expel acidified water through capillary. Lower mercury bulb. Rinse in the same way with distilled water in cup. Place about 1 cc. mercury in cup and seal stop cock B. Expel distilled water. Lower mercury in chamber to slightly below 50 cc. mark. Close stop cock A partially so mercury rises very slowly in chamber. This removes water droplets from sides of chamber. Raise mercury bulb. Expel drop of water on top of mercury in chamber. Lower mercury bulb. Apparatus is now ready for another determination.

## Computation

Subtracting the two manometer readings gives the pressure exerted by the carbon dioxide liberated from a 2 cc. portion of the 100 ml. sample solution at the specified temperature.

According to the gas law, $P \times V/T = Ps \times Vs/Ts$, the volume $V$ of carbon dioxide measured under the pressure $P$ would be $Vs$ under standard conditions. Or

$$Vs = \frac{P \times V \times Ts}{T \times Ps} \, .$$

The volume occupied by 1 gram molecular weight of gaseous substance is 22,400 ml.; if all the carbonate in the unknown were sodium carbonate, the analysis would show $Yg\ Na_2\,Co_3$ when

$$\frac{Vs}{Yg} = \frac{22{,}400 \text{ ml.}}{\text{mole. wgt. } Na_2CO_3}$$

or,

$$Vs = \frac{Yg \times 22{,}400 \text{ ml.}}{Na_2CO_3} \, .$$

Equating the two gives,

$$Vs = \frac{P \times V \times Ts}{T \times Ps} = \frac{Yg \times 22{,}400 \text{ ml.}}{Na_2CO_3}$$

or,

$$Yg = \frac{P \times V \times Ts \times Na_2CO_3}{T \times Ps \times 22{,}400} \, .$$

Here, $Yg$ represents the grams of $Na_2CO_3$ in a 2 cc. portion containing

only 1/50 of the original sample. So,

$$\text{g. } Na_2CO_3 \text{ in sample} = \frac{P \times V \times Ts \times Na_2CO_3 \times 50}{T \times Ps \times 22{,}400 \text{ ml.}}$$

and,

$$\%\ Na_2CO_3 \text{ in sample} = \frac{P \times V \times Ts \times Na_2CO_3 \times 100 \times 50}{T \times Ps \times 22{,}400 \times \text{sample}}.$$

If higher precision is desired a correction factor can be used. It is designated by van Slyke as the "i" factor (8) (4) and accounts for the $CO_2$ which re-dissolves in the solution while the gas is being compressed from 47 cc. to 2 cc. before the readings are taken. Van Slyke and Neill showed that, when the difference in the pressure readings varied from 100 to 340 mm., "i" was still the same average number (8). MacFadyen found it to be 1.003 when the reagents were dissolved in 25% NaCl solution (2). It has been found satisfactory to multiply the difference in pressure first obtained by this factor and using the resultant figure as the pressure of $CO_2$.

## Blank Determinations

A blank determination to check the apparatus and reagents may be made by using 2 cc. of 25% NaCl solution as the sample. Theoretically, no "$CO_2$" should be found in this way; practically, the correction is very small (about 0.5 mm.) and can be subtracted from the carbon dioxide pressure difference after the correction for factor "i."

## Summary

The Van Slyke-Neill apparatus can easily be presented to the class in elementary quantitative analysis. Most of the determinations carried out by beginners come within the accuracy range of $\pm 1\%$ of the theory. The method is highly instructive, yet not difficult, and should be of great benefit to the average student. Detailed directions for the analytical operation are given.

## Problems

1. A sample weighing 0.1610 g. and known to contain carbon dioxide in the form of $Na_2CO_3$ was dissolved to 100 ml. with 25% NaCl solution. Readings on the van Slyke-Neill apparatus were 154.8 mm. and 86.2 mm. The thermometer in the water jacket recorded 21° C and the blank reading was 0.5 mm. What is the percentage $Na_2CO_3$ in the sample? What is the percentage $CO_2$ in the sample?

$\%\ Na_2CO_3 = 24.5 \pm 0.24$

$\% \ CO_2 = 10.2 \pm 0.10$

2. Sample containing $K_2CO_3$ weighs 0.1928 g. Pressure readings were 207.3 mm. and 87.1 mm. Temperature was 22° C. Blank read 0.5 mm. What is the percentage $K_2CO_3$? Percent $CO_2$?

$\% \ K_2CO_3 = 41.2 \pm 0.41$

$\% \ CO_2 = 14.9 \pm 0.15$

3. Sample 0.2034 g. Pressure 186.0 mm. and 82.3 mm. Blank 0.5 mm. Temperature 25° C. ? = % $Na_2CO_3$.

$\% \ Na_2CO_3 = 29.0 \pm 0.29$

4. A sample weighing 0.5044 g. is known to contain 11.8% $CO_2$. Pressure 269.6 mm. Blank 0.5 mm. Temperature 24° C. ? = mol. wt. $CO_2$ (Do not use "i" factor here).

BIBLIOGRAPHY

1. Hamilton, Paul B., and Van Slyke, Donald D. "The Gasometric Determination of Free Amino Acids in Blood Filtrates by the Ninhydrin-Carbon Dioxide Method." *Journal of Biological Chemistry,* 150 (1943), 231–250.
2. MacFadyen, Douglas A. "Determination of Amino Acids in Plasma by the Ninhydrin-Carbon Dioxide Reaction Without Removal of Proteins." *Journal of Biological Chemistry,* 145 (1942), 387–403.
3. Peters, John P., and Van Slyke, Donald D. *Quantitative Clinical Chemistry, Methods.* Baltimore: The Williams and Wilkins Co., 1932. p. 377.
4. Van Slyke, Donald D. "Determination of Solubilities of Gases in Liquids with Use of the Van Slyke-Neill Manometric Apparatus for Both Saturation and Analysis." *Journal of Biological Chemistry,* 130 (1939), 545–554.
5. ———. "Note on a Portable Form of the Manometric Gas Apparatus, and on Certain Points in the Technique of Its Use." *Journal of Biological Chemistry,* 73 (1927), 121–126.
6. ———. Dillon, Robert T., MacFayden, Douglas A., and Hamilton, Paul B. "Gasometric Determination of Carboxyl Groups in Free Amino Acids." *Journal of Biological Chemistry,* 141 (1941), 627–669.
7. ———, and Folch, Jordi and Plazen, John. "Manometric Carbon Determination." *Journal of Biological Chemistry,* 136 (1940), 509–541.
8. ———, and Neill, James M. "The Determination of Gases in Blood and Other Solutions by Vacuum Extraction and Manometric Measurement." *Journal of Biological Chemistry,* 61 (1924), 523–573.
9. ———, and Sendroy, Julius Jr. "Carbon Dioxide Factors for the Manometric Blood-Gas Apparatus." *Journal of Biological Chemistry,* 73 (1927), 127–144.

---

Five million children were without opportunity of becoming well-grounded in the foundations of American life because they were not in school at all, according to the U. S. census of 1940.

---

*Special lens,* fitted with brackets to slide under the home television receiver, will magnify the picture of the television screen about three times without decreasing its brightness, according to claims. The lens may be adjusted vertically and horizontally to produce the desired picture size.

# MAP PROGRAM DISCUSSION*

DAVE E. SITES
*Rand McNally Co., Chicago, Illinois*

The materials to be used as aids in the teaching of any course should be determined by the objectives of that course. Before publishing a set of maps or a globe for classroom use, the publisher should carefully consider the objectives of the course and the objectives to be accomplished through the use of the materials published. As a means of improving materials in the social studies field it might be well for us to prepare tests which would find out whether the objectives sought through the use of such items are being attained.

There are certain understandings which we believe can be accomplished only through the proper use of visual aids such as globes and maps. Every adult should have in mind the picture of the world just as it appears on the globe. The divisions of the earth's surface into land and water areas should appear in the mind of an individual just as it looks on a globe rather than as it appears on any type of flat map. There should be a certain amount of detail in the picture after one has completed the social studies courses of the elementary grades and the high school. Detail such as the pattern of mountains and plains of the world, large rivers, major political units, large cities and the trunk lines of transportation on land, on water and in the air. The complete picture will also carry with it the relation of places to the equator and the poles, a very necessary understanding when thinking of climate and the question of production of agricultural products and the ways of living in the different areas of the world.

Anyone who knows anything at all about the processes of learning will at once see that you could not hope to teach everything mentioned in the preceding paragraph in the very first grade in which world geography is introduced. Yet a study of the maps in use today in a great many of the schoolrooms would indicate an attempt to do just that. Suppose I were to suggest to teachers of reading that the reader used in the eighth grade be used also in the first grade. They would probably say that I should have my head examined. Isn't it true that there are some of the same words in the eighth grade reader that the children have to learn in the first grade? "Yes," you say, "but the many words which are too difficult for the first grade stand in the way of teaching the simple words." We believe the same principle holds for map and globe reading that operates in the teaching of reading. Maps and globes must be graded so that only those features and symbols which are to be taught in the particular grade where the

* Presented at the "Map Clinic," Geography Section of the Central Association of Science and Mathematics Teachers, November 28, 1947.

materials are being used are within the understanding of the children of that grade.

In the program which we are presenting here the first step toward the use of maps for world understandings is a symbol chart. The first step in reading is taken by teaching the symbols of the language. Time will not permit us to go into detail here but note that the children are taught to associate a picture of a city with the symbol for a city and all other symbols are taught in the same way. Color is a symbol which is not used on the Beginners Maps because the things which are generally represented by color on a map are not taught to the beginners. When the word earth or world is introduced to the children we show them a very simple globe and permit them to hold it in their hands and look it over from all angles. When we want to center the attention of the whole class on a particular part of the globe we put before them one of these maps which is a picture of that part of the globe. Note the spherical impression that this type of map gives. I have often wondered what goes through the mind of the child when a teacher pulls down from its roller on the wall a flat world map and then shows the globe, telling the child in each case, "This is the world." The response of most any adult to a few questions concerning the world will reveal that the flat concept is the one that stuck rather than the globe.

The interrupted world map at the end of the Beginners series shows in a very simple way how a flat map may be made from the surface of the globe. After a year of studying the earth as a ball the child can be shown the comparisons on a flat world map that are important in the study of regional geography, provided the land areas of that world map are so projected as to make comparison possible.

Regional geography study requires some new symbols to be added to the map and to the globe. The generally recognized symbol for showing elevation is the system of hypsometric coloring used on the international map of the world. These colors show elevation, which is very important in understanding the variation toward the north or south of frost lines which determine growing seasons. They are also used for reading slope.

In addition to the equal area flat world map another type of flat world map is introduced in either the fifth or sixth grade. It is known as the Azimuthal Equidistant World Map and is designed to show relations across the north pole. World Air Routes are brought out on this type of world map. With the globe kept in constant use in relation to these maps the child will never form his concept of the world from any one of the three world maps appearing in our program.

When we reach the junior and senior high schools another color symbol comes into use. On the physical-political maps national

boundaries were shown by red lines. The so-called political map shows one color for a given political unit throughout the entire area represented on the map. This same color scheme is used also on most of the history maps. As the children reach this level they are able to comprehend the use of the legend more celarly and color may be used for a greater number of different purposes. More cultural detail comes out on these maps and is now understood because of the foundation built through the simpler maps of lower grades. Globes are made to correspond to these maps with a greater amount of detail on them also.

There is another important point in the use of maps and in learning how to interpret and use maps. That point is *learning to use maps*. Hardly a day goes by that the modern adult does not have occasion to use a map in some form or other. Or it may be that he will be called upon to visualize a map previously studied in order to understand what he may be reading in a paper, magazine, book or even a business letter.

We are presenting a program of maps which, starting with the simplest concepts, move progressively to more complex concepts as the children use them from one grade to the next. We have not reached perfection as yet and never expect to, but our social studies editors are constantly giving thought to the problem of making our maps and globes easier for the children to read and understand.

---

## MINIMUM OR ADEQUATE GEOGRAPHY MAP EQUIPMENT?*

O. E. GEPPERT
*Denoyer Geppert Co., Chicago, Illinois*

It is my understanding that the geography discussion concerns minimum equipment for geography work at various grade levels. There are a number of things that come to mind in this connection.

The necessity of adequate map equipment for the satisfactory teaching of geography is now unquestioned. If in many cases teachers are still called upon to teach without a sufficient supply of maps—to make "bricks without straw" as the Israelites were forced to do in the time of their bondage—it is not because the need of such equipment is not recognized and proclaimed by every authority which can make any pretense to a pedagogical hearing. It is rather because of what must be reckoned wholly extraneous considerations—a lack of funds with which to make the purchase, the unprogressive character of the

* Presented at the "Map Clinic," Geography Section of the Central Association of Science and Mathematics Teachers, November 28, 1947.

school officials, or a failure on the part of the teacher himself to realize what are the indispensable tools of his calling, and by insistence to obtain them.

Recently the elementary school supervisor in a large midwestern city was given the task of bringing up to date the map and globe equipment in some 70 schools. If the supervisor had been familiar with map and globe requirements in some of our more progressive states, and the accepted needs as carried out in some of the better city school systems of the country, she would have realized that her present cash requirements for each of her 70 schools exceeded $100.00 for the first six grades in each school, and an additional $100.00 for Junior High School grades, where those were included in the building. This extremely modest supervisor was allotted only a little more than $1000.00 to equip all of these schools, which are practically devoid of maps at the present time. Such maps as are present in the schools were purchased 20 or 25 years ago!

Do we make progress when we are content with minimums? Would it not be better for teachers and pupils if we thought in terms of "adequate" equipment? How can we make people aware, particularly those directly responsible for recommending equipment, that the teaching of geography requires adequate tools, and that good tools in this field cost money just as they do for manual training and other courses? Certainly in geography we have one advantage: every pupil deserves a good grounding in the fundamentals of geography, and maps and globes are needed for this work. When it comes to music, art, mechanics and home economics, expensive instruments, machines, and tools are provided for use by only part of the children; but elementary geography, so far as it is taught at all, concerns *all* of the children of all of the people.

When a board of education blueprints a new building, the architect tells them it will cost so much per cubic foot to erect the building they plan. Too often it is forgotten that the empty building, freshly turned over by the architect to the board of education, and in turn to the school administrator, is not ready for the work of teaching until it is properly equipped. Given the enrollment and number of classrooms and grades, it should be possible to blueprint the geography equipment that is necessary for successful work, and provide beforehand whatever it may require—$100.00, $300.00, $500.00—so that when the school population moves in, work is ready to proceed with efficiency and assured results.

More and more school administrators are realizing that every classroom in which geography or history is taught should have a large globe of the world. At the very least, a grade school should have a slated outline type globe and a large terrestrial globe, which together

may represent nearly $100.00 cost today. Physical-Political Maps of the continents and important areas will add another $100.00; while slated maps, a few other special maps and World maps may add another $100.00. We are finding now that materials particularly adapted for beginners' use are needed, and the probabilities are that these items will need to be added to those already mentioned.

And this does not yet get us beyond the 6th grade. If this is an 8 grade grammar school there will be need for history maps, citizenship charts, and geography materials dealing with world trade and our air age world.

It may not be generally known that many states have set up quantitative as well as qualitative standards for map equipment in the past ten years. It might be a profitable piece of work for a committee of the Central Association of Science and Mathematics Teachers to be given the task of assembling information on such standards and publishing the information so that it can be seen how much unity of thought there is on this subject, and what area of disagreement remains.

---

## FELLOWSHIPS AT CASE

Case Institute of Technology will again offer fifty General Electric Fellowships for High School Teachers of Physics for a six-week program of study during the summer of 1948, according to an announcement by T. Keith Glennan, recently appointed president of the Cleveland (Ohio) engineering college. This is a repetition of the successful educational program which was taken last summer by fifty physics teachers from Ohio, Michigan, Western Pennsylvania, West Virginia, Kentucky, Indiana, Illinois, Wisconsin, and Maryland.

Recognizing the fact that industrial research and progress stem largely from a knowledge of physics, the General Electric Company will again provide these fellowships for high school and preparatory school teachers of physics. The program is designed to acquaint teachers with recent developments and research in physics.

The General Electric Science Fellowships include all tuition fees, room and board, and travel expenses. High school and preparatory school teachers of physics from the following states are eligible to apply; Ohio, Michigan, Western Pennsylvania, West Virginia, Kentucky, Indiana, Illinois, and Wisconsin.

In commenting on the significance of the program, President Glennan said: "It is very encouraging to have the active support of such an outstanding industrial concern as The General Electric Company in this program to improve high school teaching. This partnership of business and education augurs well for the teaching of science in our high schools."

Courses in the program will be under the supervision of Dr. Elmer Hutchisson, Dean of the Graduate Division, and will be conducted by Dr. Robert S. Shankland, Head of the Department of Physics, Professor Russell C. Putnam of the Department of Electrical Engineering, and Professor Leonard E. Olsen and Mr. Earle C. Gregg of the Department of Physics. Supplemental lectures and demonstrations will be given by the scientific staff of The General Electric Company.

---

Some communities in some states in 1940 spent 60 times as much for the education of a child as did some communities in other states.

# THE CONSUMER AND MATHEMATICS

Myron F. Rosskopf
*John Burroughs School, Clayton, Mo.*

Since all of us are consumers and only some of us are teachers of mathematics, it is appropriate that the *consumer* in this paper's title precede the *mathematics*. The purpose is to propose a way in which we, as mathematics teachers, can help our junior high school charges to become better consumers. Mathematics will not necessarily help them in their battle with the high cost of bubble gum, comic books, and candy bars; but properly applied a knowledge of mathematics will enable them to buy greater satisfaction for themselves. They can be taught how to plan their expenditures in order to make their allowances last throughout a personal fiscal period.

A good mathematician should define his terms. Just what is meant by the word "consumer"? Are we not all consumers? What is "consumer mathematics"? Is it not true that in the final analysis all mathematics is consumed; that is, used in one way or another? And what do we mean by "greater satisfactions"? How should these terms be delimited in order that a practical classroom approach can be made?

The *Consumer Education Study* of the *National Association of Secondary-School Principals* under the direction of Thomas H. Briggs devotes one of its pamphlets to a discussion of these questions, but in the larger sense of the whole of consumer education. In view of this extended analysis already in existence it would be foolish to attempt definitions in the short time available. After reading and studying this unit, whose title is *The Modern American Consumer*, one is apt to come away with the belief that consumer education is the whole curriculum, too big a job for one subject matter teacher to attack. That is the easy way to evade the issues raised by the *Consumer Education Study*. That is forgetting the spirit of teaching and remembering only the bare bones of content. There are few finer statements than that of the purpose of consumer education being "to help people become more intelligent, more effective, and more conscientious consumers."[1] These words have important implications for teachers who are seeking to form the minds and habits of action of young people.

Consumer mathematics can be of great assistance in this project. What is required is that teachers examine the material being used in the classrooms to see if it is up to date. This does not mean that a teacher is to present consumer material as an illustration of the use of mathematics, as so often is done with so-called practical examples. No, it means rather that mathematical processes are taught in this

[1] Consumer Education Study of the National Association of Secondary-School Principals. *The Modern American Consumer*, 1945, 48.

new setting, or matrix, of abundant consumer material. Some of you will be disappointed when I confess that I have no startling innovation in teaching to present to-day. All I can do is urge you to re-evaluate the objectives of mathematics teaching at the junior high school level, examine the material available, and use those materials to attain the objectives which will best fit the student for playing out his role as a responsible citizen of our democracy.

Contemporary publications in book and pamphlet form are a fruitful source of material for consumer mathematics units. However, it is not necessary for a teacher to organize a whole course in consumer mathematics; there is some question of the wisdom in such a procedure. I have found it most effective in my own school to teach isolated units, introducing them at appropriate times in the course of the junior high school mathematics program. A synopsis of three of my own experiences will illustrate what is meant.

Every eighth grade text has a chapter on taxes. It occurred to me that this chapter would live for my thirteen year olds and become more meaningful to them if a study was made of local taxes and a local tax budget. Several copies of the St. Louis city budget were obtained and studied. It became clear to the class that a city budget is a complex statement. Furthermore everyone was not interested in the same division of the budget. In order to work effectively and to allow each to follow his greatest interest the class suggested organizing itself into committees; these committees or members of them gathered materials, visited the library, consulted other teachers, suggested and arranged for trips into the community. As the work progressed instruction was given on ways of presenting data in tabular form, in various sorts of graphical form, or in the form of a formula; much work was done with all sorts of percentage problems; the fundamental processes came in for a great deal of attention, too. Each committee accumulated much data; voluminous reports on an individual basis did not seem feasible. Through discussion of several proposals it was settled that (1) each committee would co-operatively construct a notebook report, which everyone could read; (2) each member of a committee would contribute some piece of work to the report; and (3) each committee would select a speaker whose duty it would be to present the committee report to the whole class. The committees elected their own chairmen who were responsible to me for the activities of their respective committees. It was surprising how well a group worked together when interested and how wise their choice of chairman was.

The time spent on this unit was five weeks, a longer time than covering the text chapter would have taken. Using so much class time requires some justification; it can be said that much more mathe-

matics was taught much more effectively than usual. In addition more than mathematics was taught. These students finished the unit study with a realization of the complexity of taxes and the many services government furnishes; in short they acquired a better and healthier appreciation of the way in which the tax dollar is spent. An attitude test given at the beginning of the unit study and at the end gave evidence that changes had taken place.

During a study of equations and formulas in ninth grade algebra an opportunity was presented for teaching some safety facts. The problem chosen was that of the distance necessary to stop a car after the danger is seen. As is well known many accidents are caused by a driver's failure to allow himself enough distance in which to apply brakes. At first the class worked with the distance, rate and time formula, computing the number of feet a car would travel in one second at typical driving speeds in the city and on the open road. A study of safety literature by members of the group brought the phrase "reaction time" to their attention. It was a simple matter to explain the meaning of this phrase but it proved to be difficult to devise means of measuring individual reaction times of the class. The best that could be done was to borrow stop watches from the physical education department, practice their use, and set up situations in which teams could measure one another's reaction times. The results were very inaccurate but they did serve to give the class data for a correct conclusion:—reaction times vary from individual to individual. Now it was possible to work out personal braking distances and a class average braking distance. To clinch the idea that braking distances are large and to give each member of the class an actual distance to use as a yardstick in judging braking distances the class went out on the school grounds with tape measures and laid off the computed figures.

One other example will suffice to illustrate the use of consumer mathematics material with a ninth grade class. The work in social studies and mathematics is so arranged that at the same time that the social studies class is studying the question of advertising and using their analysis as an illustration of the use of various propaganda devices the mathematics class makes a study of labels, canned goods sizes, and comparisons of costs per ounce. It might be objected that such simple arithmetic has no place in algebra. However, the material furnishes a good review of the fundamental processes and an excellent opportunity for teaching division on the slide rule, placing of the decimal point, use of formulas, estimation of results, and the like. In particular, in a school where general education and preparation for college must be carried on in the same set of courses, this arrangement of a course of study enables the faculty to cut across subject

matter lines in its teaching and to achieve in some small way transfer of training.

A few remarks on courses in general mathematics will conclude this paper. There is no general mathematics course taught in my school, but the faculty is keenly interested in general education. As a result there is a continuing search for materials of instruction and for organizations of areas of learning in order to achieve the philosophy of education which has been written for our school. The old questions of scope and sequence, you see. There have been successes and failures, naturally, in this search. The use of consumer education material may be the answer to both the cry for a *good* general mathematics course and to that of inclusion of mathematics teachers in broad phases of the curriculum. Too often mathematics teachers are put off by themselves in a subject matter department, blocked off from the "interesting" developments in the school curriculum.

Anyone who had experience with training of men, particularly air corps cadets, during World War II will remember the academic weaknesses of large numbers. In my own experience the greatest weakness was in written and oral English; secondly, these cadets lacked a knowledge of the fundamental concepts of mathematics. Again and again one would say to me, "I wish someone had made me take more math." It is pretty well agreed that a large number of junior high school students require some mathematics course in the ninth grade which is less abstract than the usual algebra. Mathematics teachers on the other hand believe that there are concepts basic to all mathematics which should be taught in this grade. Is it not possible that what we need is a change of material? To me consumer education materials furnish an excellent means of permitting mathematics teachers to teach the concepts *they* insist upon and to satisfy the requirements of general education which curriculum experts insist upon. Perhaps, returning to our war time experiences in teaching, we cannot anticipate future needs in training, but we can furnish our students with a basic experience in many areas of learning, of which one is mathematics, in order that they will have a chance, when the situation arises, to go on with a further, specific sort of training.

---

Ten million adults in 1940 had so little schooling as to be almost illiterate. Three million of this number had never been enrolled in any school.

---

*Fiberglas* acoustical tiles for room ceilings and sidewalls are noncombustible and have high sound-absorbing properties. Painted white at the factory, the one-foot-square light-weight tiles can be cemented to a solid backing or held in place by wood or metal furring strips.

# THINKING VERSUS DOING IN BIOLOGY[1]

MAITLAND P. SIMMONS
*Irvington High School, Irvington, New Jersey*

In order to provide a background for this activity, a daily assignment should be made previous to the lesson-unit. The assignment should consist of ***Introductory Questions*** taken from the Topic Study. Material relating to these curosity questions may be found from the instructional illustration, their textbook, and reference books.

Before the class enters, all materials for the activity should have been set up and arranged by the instructor ready for pupil-teacher participation during the class period. This will save class time on the part of the teacher and pupil and is an efficient way of handling large classes.

To obtain the best results, students should be encouraged to answer all questions and to record observations with sketches, independently in their individual booklets. This work should be held to a high standard of accuracy, but, on the other hand, should allow for originality of expression.

To summarize the concepts set forth, it is suggested that the *Interpretation Questions* at the end of the Topic Study should be given as an assignment, or should be discussed.

## UNIT: ANIMAL LIFE

### Topic Study: Bird Life[2]

#### Introduction

1. What is your favorite bird? Why?
2. How were birds considered to be of importance in the discovery of America?
3. Report on the lives and works of Edward W. Bok, Dr. Frank M. Chapman, John James Audubon, and Louis Agassiz Fuertes.
4. What unusual birds may be found at the Singing Tower, Lake Wales, Florida and on Guadalcanal?
5. Why did Salt Lake City erect a statue to the sea gulls?
6. What is the Boy Scouts' Bird Study Merit Badge?[3]
7. In what ways does the banding of birds (identification rings around leg) help us in the study of bird life?

---

[1] For the same type of organization and presentation of content, see: Simmons, Maitland P., "Thinking Versus Doing in General Science," SCHOOL SCIENCE AND MATHEMATICS, Vol. XLVIII, No. 2, pp. 86–90.

[2] *Bird-Lore*. Crescent and Mulberry Streets, Harrisburg, Pa.: National Association of Audubon Societies. The bi-monthly magazine contains a surprising amount of interestingly presented information with excellent photographic illustrations.

[3] *Handbook for Boys*. 2 Park Ave., New York City: The Boy Scouts of America, 1940, p. 578.

## Activity: Identification of Common Birds[4]

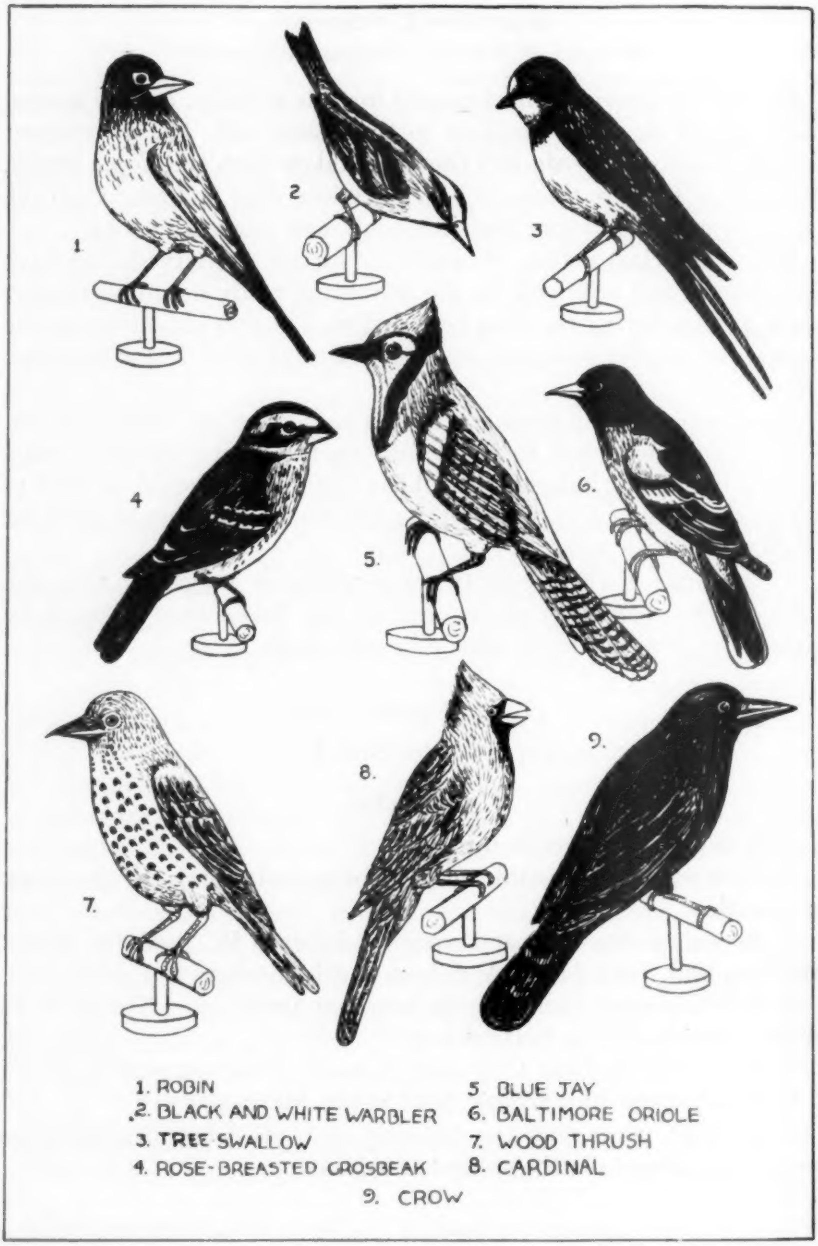



Fig. 1. Mounted specimens[5] of American birds.

8. What contributions to the cause of the conservation of bird life did each of the following men make: Theodore Roosevelt; Dr. William T. Hornaday, former director of the New York Zoölogical Gardens; Dr. Thomas G. Pearson, former president of the National Association of Audubon Societies, New York City; and Jay N. Darling, former Chief of the Biological Survey, Washington, D. C.?

9. Do you think bird life is more important now than a hundred years ago? Explain fully.

10. Do you believe that cats should wear collars with bells? Why?

11. Name the official bird of your state; a bird that is known to be a sheep killer; a bird that is able to catch insects on its wings; the bird that can fly backwards; the bird that can run faster than a horse, make a noise like a lion, but is unable to fly; and the bird that has a tail four times as long as its body. What kind of noises does the latter make?

12. How many times larger is the ostrich than the humming bird?

13. Why do birds lay fewer eggs than lower forms of animals?

14. Describe a species of bird known to be very unlike other birds.

15. Give a list of birds that are named after the sound they make.

16. Why does the mourning dove still exist while the passenger pigeon does not? What other birds are now extinct?

17. Name some birds that can fly as soon as they are hatched.

18. Give a brief description of the rifle-bird.

19. List some points you would consider in the selection of a pet canary.

20. What causes the bright colors of color-fed canaries to fade out?

Directions for Study:

Display as many colorful life-sized models of birds as are available. They need not be those in the illustration. *Important:* Since the speci-

[4] Audubon, John J. *The Birds of America.* New York: The Macmillan Co., 1941. The book contains 435 beautifully full-colored plates with concise characteristics of each illustrated bird.

Ball, Alice E. *American Land Birds.* New York: Tudor Publishing Co., 1936. The book contains 47 full-colored plates with the characteristics across from each picture.

Grosvenor, Gilbert and Wetmore, Alexander (Editors). *The Book of Birds.* Washington, D. C.: National Geographic Society, 2 Vol., 1937. The book contains 950 colored plates. See *The National Geographic Magazine* (August, 1938; December, 1938; March, 1939; June, 1939; May, 1940; January, 1941; June, 1942).

McKenny, Margaret. *Birds in the Garden.* New York: Reynal and Hitchcock, 1939. The book contains 16 full-colored plates.

Neltje, Blanchan. *The Nature Library Birds.* Garden City, New York: Doubleday, Doran and Co., 1927. The book is exceedingly interesting with 48 excellent full-colored plates.

Pearson, T. Gilbert (Editor). *Birds of America.* Garden City, New York: Garden City Publishing Co., Inc., 1936. The book contains 106 excellent full-colored plates.

Robert, Thomas S. *Bird Portraits in Color.* Minneapolis: The University of Minnesota Press, 1934. The book contains 92 exceptionally fine full-colored plates.

[5] Colored Audubon charts may be used in addition to or substituted for the specimens. Several days may be needed for this lesson, depending on the amount of material available. A visit to a museum can supplement the work.

mens are delicate, handle them *carefully*. (For the temperate zone, the spring is the most appropriate time for this lesson.)

Suggestion: To create class interest, offer a prize to the pupil naming the most birds.

Observations from Study and Previous Outdoor Experience:

Name some common birds that you can recognize by sight. Give another common name for the quail. How are birds economically important to man? Name and identify twenty wild birds common during spring and fall in your vicinity. Which bird is the most unusual? What birds arrive first in your locality each spring? What winter visitants can be observed in your vicinity? List the seed-eating birds that you are familiar with. Name the insect-eating birds common in your area. What countries have an agreement protecting this type of bird? How is the shape of the birds adapted for flight? Of what advantage are their various color schemes? What are some uses of their tails? How is the shape, size, and sight of the eye different from that of humans? What special adaptations enable woodpeckers to cling to trees and to get ants from an ant hill? What is the use of the long pointed beak? How do herons and cranes use their long legs and beaks? Describe the beak of a humming bird. What is the purpose of the hairs around the beak of the whippoorwill? What other birds have special adaptations for their modes of life? What five characteristics would you consider in attempting to identify birds?

Interpretations

1. When asleep, why doesn't a bird fall off its perch (branch)?
2. What methods do birds use for obtaining food? Why do they eat often? Name four favorite foods of the bobwhite.
3. How are birds adapted for escaping enemies?
4. Do birds use their legs when flying? Why?
5. Why can the penguin get along without wings? How does this bird keep the eggs warm until they are hatched?
6. How many scavenger birds can you identify? Describe them fully.
7. Compare the robin with the English sparrow as to merit.
8. How does the pelican feed its young?
9. Describe the activities of birds before and after a rain storm.
10. Of what value are house wrens? Describe their song. Why do all male birds do most of the singing?
11. How do you explain the ability of birds to find their way when migrating? During what time of day do they migrate? What dangers are encountered? Name a bird that does not migrate.

12. If all birds were exterminated, would other kinds of life be affected? Explain.

13. How can you explain the brilliant and somber colors in the plumage of birds?

14. Why do robins cock their heads on one side?

15. Is there any law in the United States forbidding the use of wild bird feathers as trimming for hats? Explain.

16. How can birds hear when they have no external ears?

17. In what ways are bats different from birds?

18. Why have English sparrows become more plentiful than the native birds whose place they took?

19. How is it possible to change the direction of the flight of a homing pigeon?

20. What bird calls can you distinguish and imitate?

21. How have the following laws helped in preventing the wholesale destruction of birds: (a) The Migratory-Bird Treaty Act,[6] (b) The Lacey Act,[7] (c) The Tariff Bill of 1913 (Plumage Section)?

[6] Fitzpatrick-Horton. *Biology.* Boston: Houghton Mifflin Co., 1940.
[7] *Ibid.*

---



---

Twenty-five per cent of our people over 25 years of age in 1940 had six years or less of schooling.

# A MUSEUM TEACHES

DONN BRAZIER
*Education Department, Milwaukee Public Museum, Milwaukee 3, Wisconsin*

In the last school year, 1946–1947, nearly forty-two thousand public and parochial school children of the fifth through eighth grades participated in the educational program of the Milwaukee Public Museum. Following an administrative schedule arranged by the school systems, about two hundred and fifty boys and girls from the public schools arrive each morning at 9:00 to spend two hours with us in a carefully planned sequence of activity. Another group of similar size from the parochial schools, including both Catholic and Lutheran schools, arrives at 1:15 in the afternoon and follows an identical program.

Since this museum activity began—even before the creation of the museum's Education Department in 1921—many extensions and improvements have been made in tools and techniques to make the teaching program a balanced learning experience for each child. Until recently, the program consisted of a colored lantern slide lecture, followed by a guided tour of selected exhibits among the museum dioramas.

The first change in this pattern was the substitution of a more modern tool for the slide talk: the motion picture, preferably with both sound and color. The next change added a third technique to the sequence of learning activities. This change was forced upon us by an observation every one of us in the department had made countless times. We had always noticed the way the children pushed their noses against the glass barrier of the exhibit case, the way their hands were always eager to touch. Now, if they could only handle the objects they looked at so longingly, if they could only see the things in action, then learning would be real. To satisfy this need, a demonstration program was organized as a part of the basic formula.

Let me mention at random a few of the things done in the demonstrations during the last year, when seven different subjects were presented. While listening to an old Sousa march, a boy and girl dressed in "gay nineties" clothing looked through the stereoscope. The actions of loading and firing a flintlock musket were simulated. (See Fig. 1.) The audience was challenged to play the Indian "pin and cup" game and to keep the Indian whip top spinning. A real branding iron was used to brand pieces of cardboard, which were later passed out as souvenirs. The boys thrilled to the touch of real "wild west six-shooters"; some of the girls, however, passed the revolver along with two fingers, as though it were a red-hot poker. Two boys sawed a log on the stage with a lumberman's crosscut saw and

learned that it was not quite so easy as it looked. In an unprecedented experiment, groups of about forty children were taken right past the glass barriers into the colonial kitchen habitat group, where they sat in a semi-circle before the fireplace while the demonstrator, dressed as a pioneer, passed around many old articles and spun flax on the spinning wheel. (See Fig. 2.) With a plug made from a section of garden hose, the demonstrator cast out into the aisle with a casting rod to show the action of rod and reel. The safe handling of firearms was demonstrated, as well as safety in the water and in the woods. Jars containing living pond animals fished from aquaria on the stage were passed around, and a simple balanced aquarium was made by one of the pupils right before the audience.

FIG. 1. This fifth grade girl must pause in her grinding of Indian corn with a real Indian mortar and pestle to help the boy hold an old flintlock musket as he pours "powder" onto the flashpan in simulated loading and firing. Note, too, the colonial costumes, a vital part of the Demonstration Program.

The objects needed for demonstrations are largely obtained from the curators of the different departments here at the museum, but sometimes the things we want are not available. Living things must be collected from ponds, streams, and woods. Various service agencies have been cooperative, such as the Forest Service, which supplied forest firefighting equipment, lumbering tools, and even a ten-foot aluminum model of a fire tower. Business establishments cooperate with loans and gifts of needed material. A pet store supplied aquaria.

water plants, and fish; a company supplied several complete deep-sea diving suits and helmets; a hobby shop supplied model airplanes and an airport supplied real airplane parts; a ranch supplied several sections of a real corral fence, branding iron, saddles, and other cowboy equipment; the Link Trainer Corporation even furnished one of their school Links, with a capable instructor, who stayed here an entire month and gave the demonstration part of the program for us. Thus, with a little effort, it is fairly easy to get the material needed for an interesting demonstration program.

As you might have guessed, this part of the program is the most eagerly anticipated, because students are selected as helpers and demonstrators whenever possible. "Pick me, pick me!" is a constant

FIG. 2. Seated before the fireplace *inside* the habitat group, fifth graders watch Miss Edith Quade spinning flax. The boys then tested their strength against the homemade linen thread.

refrain when pupils are being selected, and those that are finally taken are the envy of their classmates.

The children also enjoy the tour of the exhibits, an activity that we call the "floor tour." (See Fig. 3.) The motion pictures, which last nearly an hour, usually come first in the educational program, and are seen by the entire group at one time. When the lights come up, the pupils leave their coats in the seats and pass out of the lecture hall, each receiving a pencil stub, a question sheet, and a clip board on which to write. Half the group then passes back into the lecture

hall to the front seats for the demonstration, while the other half is divided into two sections for the guided floor tour. Each floor tour section lasts fifteen minutes, so that in half an hour the floor tour group comes back to the lecture hall to see the demonstration, while the group that has just seen it goes on the floor tour.

Our question sheet is now 5×8 inches, printed on both sides, so that there are two sections of questions to correspond with two different areas on the museum floor. Formerly, these parts were marked A and B, and the questions were numbered, with corresponding numbers on exhibit cases. We observed, however, that the children would ask, "Where is Number Five?" If they asked at all, we wanted them to ask for the object by name, as, "Where is the calabash?" Therefore, we dropped the A and B designation and now use a bull's eye on one side and a star on the other. On the exhibit case glass we paste a star and the object's name, repeating the star for each object in that section. Now the children do ask, "Where is the calabash?" But more often they are happy to scurry about, looking for the stars in a sort of game and preferring not to ask at all. This has shortened the question answering time, so that we can take a little more than the last five minutes of the fifteen-minute period for

FIG. 3. Part of a "floor-tour group" observes a pineapple and answers the question on the question sheet. They will answer ten questions in ten minutes and then discuss the answers for five minutes with the guide.

group discussion and correction of the papers. The papers are usually kept by the pupils, although sometimes the teachers collect them.

If you will refer to Table 1, you will see our schedule for 1946–47. During one year a given child will twice take part in our program. As closely as possible, subjects are selected to fit the school's curricula, though we try to vary the program for the same group as it moves up year by year, so that geography, history, and natural history are alternately presented.

Since we are not able to furnish transportation, we try to schedule the lower grades in the months of good weather, as the older boys and girls can better cope with the snow and cold of the winter months. This does not always work out, because the subject, such as "Exploring a Wisconsin Pond," may be one that should be given in the spring, when living demonstration material can be obtained.

The explanation for the lower attendance figures in the seventh and eighth grades is that many Milwaukee schools are departmentalized after the sixth grade, or stop at that level in junior high school districts. Some schools, seeing the value of our program, have nevertheless surmounted the added administrative difficulties of a departmentalized system and have arranged to attend.

Until recently, our program was more or less isolated from the teacher's own lesson plans. This has been rectified. With the cooperation and assistance of the Curriculum Planning Council, and especially Raymond A. Petrie, Supervising Assistant in Audio-Visual Education, a teacher's guide outline was set up. For each program, now, this outline is completed and distributed in mimeographed form to each teacher well ahead of her visit to us. This guide gives the teacher assistance in developing motivation, in developing a readiness to observe through a section of the outline called "Points to Look for," in developing an understanding of new words that will be encountered. *The Teacher's Word Book of 30,000 Words* by Thorndike and Lorge is often consulted in making this list of new words.

The guide also contains suggestions for follow-up activities in discussion, dramatization, research reading, composition, creative activities, and demonstrations. A short follow-up test is provided. Most teachers have been especially enthusiastic over the "new word list" and the follow-up test. And to make the guide more valuable still, it includes a bibliography of films, exhibits, and books that can be borrowed from the museum and the library.

Teachers have been very generous in their praise of our program and the teaching guide that precedes it. But the real gratitude comes from seeing the delight with which the boys and girls enter into the program, and the thrilled looks on their faces as they handle a harpoon that an Eskimo once threw into a seal, or as they watch the

demonstrator hit the mark with a blow gun used by the South American Indians. It is a pleasure to teach when the learning is such pleasure!

TABLE 1. MILWAUKEE PUBLIC MUSEUM EDUCATIONAL PROGRAMS GIVEN IN THE 1946–1947 SCHOOL YEAR

| Month | Program | Grade | Attendance |
|---|---|---|---|
| September | Early Milwaukee | 7 & 8 | 7841 |
| November | Indians: First Americans | 6 | 7168 |
| January | Our Western States | 5 | 6659 |
| February | Our National Forests | 7 | 3888 |
| March | Colonial Life | 5 | 6963 |
| April | Outdoor Wisconsin | 8 | 2932 |
| May | Exploring a Wisconsin Pond | 6 | 6348 |

## PROGRAM OF SPECIALIZATION IN ELEMENTARY SCIENCE

Beginning in the fall of 1948, the New York State College for Teachers at Buffalo will institute a special program designed to train elementary teachers with a special competence in the field of elementary science.

This specialization has been set up in response to a very definite need. Thus, a committee of the New York Association of Elementary School Principals in summarizing 620 questionnaire returns from elementary schools of the state, reports that virtually all schools have an elementary science program of one sort or another, a program taught in most cases by the classroom teacher, herself. However, the principals are apparently not completely satisfied with these programs for this same report states that the greatest obstacle to more and better science is "lack of teacher education in science." One solution to this problem is evidently more science for all general elementary teachers. Another solution would seem to be to give a certain portion of the group of general elementary teachers-in-training a rather extensive, although broad, program of science courses. Such persons would still be elementary teachers but because of their special interest and competence would serve to better the science programs of schools into which they go through aid they may give to other teachers as well as through work in their own classrooms. The specialization program at Buffalo is designed to train persons of this sort.

The program is set up within the framework of the existing general elementary curriculum. In September, 1948, and each year thereafter it is planned that one section of the sophomore class will be formed of persons who have been admitted to the program. The exact sequence of science courses to be taken by any individual will depend in part upon the science preparation, but a typical program would include; a year, each of physical science survey and biology; single semester courses, *Science in the Elementary Grades* and *Field Course in Science;* electives in science to round out the program. The practice teaching experiences of this group will be planned to include situations where a good elementary science program is under way. By utilizing the electives in the present general elementary program, this science specialization may be followed without disturbance of the requirements in the present four-year curriculum. Hence, and desirably, the graduates in this special program will be elementary teachers with a special interest and competence in science, rather than subject matter specialists who happen to teach in the elementary school.

Persons interested in obtaining further details should write:

H. EMMETT BROWN
New York State College for Teachers
Buffalo 9, New York

# MATHEMATICS FOR THE OTHER EIGHTY-FIVE PER CENT

William A. Gager
*University of Florida, Gainesville, Florida*

"Our present mathematics curriculum meets the needs of only five per cent of our population," so states Dean Frank N. Freeman of the University of California.[1] Considering the difficulties involved in arriving at such an estimate, and the fact that less than fifteen per cent of our high school graduates have been enrolling in colleges, let us be generous to the extent of claiming that our present traditional mathematics offerings serve about fifteen per cent of our high school population.[9]

A very important question naturally follows: What about the other eighty-five per cent? The members of this group are bound to be consumers; certainly they will be our future citizens; and most assuredly they will be involved in a multiplicity of social, business, economic, and industrial ventures. Is is sensible to assume that the members of this eighty-five per cent group will have no use for methods of computations, quantitative relationships, and other important mathematical concepts? Will the members of this group be prepared to live their lives just as fully and completely without what we call "functional competence"[3] in mathematics?

The latest terminology in mathematical curriculum development seems to be to express the sequences of courses in terms of tracks. "In this double-track age" is the way Price[8] leads into one of his mathematical discussions. "Algebra for some and general mathematics for the rest" is a double-track suggestion made by the Post War Commission on Secondary Mathematics.[3] Douglass[4] writes about "Mathematics for All and the Double Track Plan—Track One for the Masses and Track Two for the Specialist." These references are enough to indicate that we are very much double-track conscious.

When one considers the rapid increase in enrollment in the ninth grade, the variations in the native abilities and interest of ninth graders, and the tremendous range in their mathematical competence,[7] this so-called two-tracked plan appears to be a very workable procedure. That it has not measured up to expectations is shown by the fact that a great many schools have been following this plan—that is "algebra for some and general mathematics for the rest"—and the results have been disappointing.

The truth of the matter is that the two-track plan exists in name only in most secondary schools that profess to follow it. What is called the two-track plan is nothing more than one main track with some spurs, where the main track always has been reserved for that

selective fifteen per cent who study algebra, geometry and the other traditional courses. The other eighty-five per cent have been side-tracked to the dead-end spurs and subjected to all conceivable types of questionable offerings under such "catchy" names as applied mathematics, consumer mathematics, economic mathematics, essential mathematics, everyday mathematics, general mathematics, home and job mathematics, living mathematics, mathematics at work, practical mathematics, purposeful mathematics, social mathematics, shop mathematics, useful mathematics, vital mathematics, ad infinitum.[2] Isn't it easy to see that in our efforts to get away from traditional ninth grade algebra we have been performing like the man who jumped on his horse and galloped off in all directions? Isn't it easy to see that our present curriculum offerings fall far short of our mathematical needs?

Worthwile educational developments usually come about as evolving processes. We might therefore feel that the reasonable thing to do is to give the general mathematics idea more time with the hopes that it will eventually evolve into a worthwhile track for the eighty-five per cent group. Certainly the fundamental principles upon which general mathematics rests are sufficiently basic to justify at least a fair trial. Yet a *laisser faire* attitude cannot be tolerated at this time; the course should not be permitted to continue to evolve in the manner in which it has been developing. The unfavorable reaction to general mathematics has now reached an all time high. The stigma attached to it is such that nothing short of a major operation will be able to make it properly function.

Before proceeding further I would like to acknowledge that we do find the general mathematics program contributing in a very commendable way to the mathematical understanding of our larger group in some of our schools. I am moved to express my deep gratitude to those faithful teachers, educators, and text-book writers who have labored, far beyond any required service, to make general mathematics what it ought to be. This group cannot be too highly praised. In general, though, the cards have been stacked against them. Tradition, poor text materials, poorly trained teachers for this type of teaching, open opposition from many good teachers, inadequate counseling, and just plain inertia, all these factors have played a part in defeating their efforts.

Regardless of any merits which might be contained in a two-track plan, what possible advantage could it have over a one-line mathematics track unless the school leaders who are responsible for sound counseling see to it that the pupils get on the proper track? The tendency seems to be for many of our counselors to shove all but the very worst mathematics pupils into traditional mathematics courses

and then consider the counseling problem correctly solved. School leaders who have counseled this way clearly show that they do not understand what general mathematics should be: that it should require as much thought and effort as any other good mathematics course; that the outcome from the course should be every bit as vital as the outcomes from an algebra course; that the course should be unexcelled in its application of basic mathematical concepts to real life situations. Because so many school leaders have not realized these facts they have played a significant part in making general mathematics what it should not have been.

One often hears that the reason many pupils are placed in general mathematics is that they do not have the mathematical background or native ability to succeed in algebra.[7] If general mathematics were what it should be why would not one be justified in assuming that these same pupils for the same reasons do not have what it takes to warrant their being assigned to a properly organized course in general mathematics?

To be sure there are some ninth grade students who are almost devoid of mathematical ability. Even here the number is much smaller than most of us are willing to admit. In any case these pupils usually know their condition and we know it well enough to provide for it. But the common practice of consigning such pupils to general mathematics and then lowering the course offerings to mesh with their abilities has had much to do with spreading the impression that general mathematics was primarily a make-shift course for weaklings.[5]

We are aware also that many administrators have permitted too many of their best teachers to scheme around or wiggle out of the responsibility of teaching the general mathematics courses. This practice is most unfortunate. Any administrator or teacher who is guilty of such practice certainly has added injury to a good cause. He has failed to realize that the mechanics and breadth and depth of teacher background needed to teach general mathematics are so much greater than those required by traditional courses that only the good teachers are capable of rightly doing the job.

It has been previously stated that our best pupils are usually placed in our algebra classes. I wonder just how much we realize that some superior pupils do not choose to study traditional algebra. Many of these pupils have thought about the mathematical offerings sufficiently to conclude that the objectives of general mathematics appear to offer them more what they want than is offered by algebra. This situation however puts us right back on the horns of a dilemma where we must ask, is it treating any of our pupils right to continue to offer a type of general mathematics which carried with it a stigma as to

name, as to content, and as to respectability among pupils, teachers, and administrators?

If we could afford to be pessimistic about it the status of our present mathematical offering for the other eighty-five per cent is almost bad enough to make us so. On the other hand there are good reasons for being optimistic about our mathematical possibilities. For one thing the milling around which we have been doing, as indicated by our offering general mathematics under such an avalanche of confusing names, has caused us once again to focus our attention on the fourth and sixth chapters of the *Fifteenth Yearbook of the National Council of Teachers of Mathematics.* If what is suggested in these chapters will only challenge more of us to apply our efforts to this general mathematics problem, then I believe there is real promise of soon having a properly balanced mathematics program functioning in our high schools.

It seems to me that the first step necessary to bring our secondary mathematics program into proper balance is to make two admissions and really mean them: first, that general mathematics was never designed to be a dumping ground course for inferior pupils or for any other type of pupils; and second, that even though algebra is a good course and a basic course in some lines of work it is not one of the seven wonders of the world.

On the assumption, therefore, that general mathematics is to be a good substantial and highly respected sequence of topics for some eighty-five per cent of our high school population, and that traditional mathematics is primarily to be for the other fifteen per cent, I would like to make the following proposal:

(a) that the word "general," and all other words that have preceded or followed the word "mathematics" to denote general mathematics, be dropped;

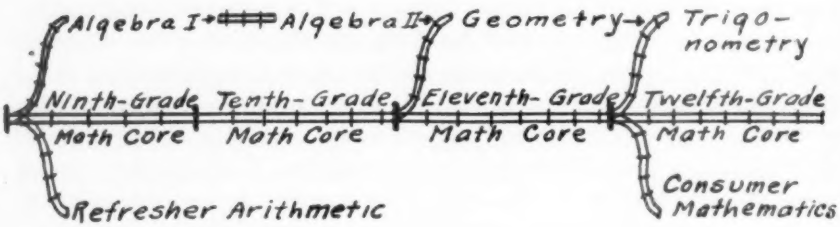
(b) that the main-line track through high school be reserved for a "mathematics core" consisting of ninth-grade mathematics, tenth-grade mathematics, eleventh-grade mathematics, and twelfth-grade mathematics.

Along the same line of thought suggested by my proposal the *Fifteenth Yearbook of the National Council of Teachers of Mathematics* has this to say:

> It is undesirable to regard any high school year prior to the last as a "terminal" year for mathematical study, and to crowd into it numerous unrelated topics simply to make sure that the pupils will have encountered them. Pupils need to meet important topics repeatedly on successively higher levels. Maturity also is requisite for the proper understanding of portions of the subject. It is therefore necessary to have a mathematical curriculum that runs through several years according to a systematic plan.[6]

If I were presenting a double-track plan I would now suggest a

second track for the traditional courses. However for the very good reason that our past experience shows that we are not yet ready for it I am not advocating a two-track plan at this time. Possibly we will never be ready for it; possibly we will never need it. Consequently the diagram which follows suggests that a main-line be provided for the "mathematics core" for the eighty-five per cent group, and that all other courses—traditional and otherwise—be assigned to spurs.




The traditional courses have purposely been assigned to the spurs to impress the advocates of "traditional courses only" that the fifteen per cent group from now on will have no justifiable right to ride the main track to the exclusion of the other eighty-five per cent. Everyone recognizes that these traditional mathematics courses are key courses for many types of work and for many of our pupils. The point is however that these courses are not so important that they should be permitted year in and year out to keep our high school mathematics program out of balance.

It is to be hoped that the content of the proposed "mathematics core" will rapidly be made such that the best possible training for all members of the eighty-five per cent group will be found in it. If however, as stated before, a few of the pupils are so totally deficient in mathematics that special provisions must be made for them, then the larger school might offer refresher arithmetic in the ninth grade and consumer mathematics in the twelfth grade as suggested by the diagram. May it be emphasized though that the number assigned to these courses should be very small and assignment should be made only after very careful counseling.

A few more hopes will be expressed as to what this ninth-, tenth-, eleventh-, and twelfth-grade mathematics for the other eighty-five per cent may accomplish.

(1) This "mathematics core" should include all the basic mathematical topics and concepts applying to real life situations that can be successfully presented on the secondary level. These materials should be arranged over the four year sequence with due regard to needs, difficulty, maturity, and terminal possibilities.

(2) The content of the "mathematics core" should be of such a nature as to assure, in the hands of competent teachers, functional competence[3] even for the average or weaker high school pupils.

(3) The "mathematics core" should not be designed to meet college entrance requirements. On the other hand the nature of the content of these courses can be such as to fully meet the desired conditions and at the same time be such that the colleges will soon be willing to accept them as entrance credit in mathematics for the A and B pupils.

Today more than ever before in the history of mankind we are recognizing the importance of mathematics in the affairs of every day living. This revived interest in mathematics places a real responsibility on our shoulders. We are now challenged to do for mathematics on the secondary level what transportation, industry, and many other enterprizes have been doing since the war, that is, rebuild our offerings. We must bring our mathematical equipment for our high school pupils, especially that other eighty-five per cent, up-to-date. Only by meeting this challenge can we hope to train high school graduates who will be able to serve accurately and efficiently in the many situations that involve mathematical concepts.


Bibliography

1. Burr, Harriette, "Mathematics in General Education," *The Mathematics Teacher*, February 1947, pp. 58–61.
2. Carnahan, Walter H., "Ninth Year Mathematics," *The Mathematics Teacher*, February 1947, pp. 79–83.
3. Commission on Post War Plans, "The Second Report of the Commission on Post War Plans," *The Mathematics Teacher*, May 1945, pp. 195–211.
4. Douglass, Harl R., "Mathematics for All and the Double Track Plan," School Science and Mathematics, May 1945, pp. 425–435.
5. Fabing, C. C., "The Problem of a Non-College Preparatory Curriculum in Mathematics," *The Mathematics Teacher*, January 1947, pp. 8–12.
6. Fifteenth Yearbook of the National Council of Teachers of Mathematics, "The Place of Mathematics in Secondary Education," New York: Bureau of Publications, Teachers College, Columbia University, 1940, pp. 73–74.
7. Hawkins, C. E., "Mathematics in the Modern School Program," School Science and Mathematics, June 1947, pp. 569–571.
8. Price, H. Vernon, "We Can Remove the Stigma from General Mathematics," School Science and Mathematics, May 1947, pp. 446–450.
9. Schult, Veryl, "Direct Segments of the School Population," *The Mathematics Teacher*, December 1947, pp. 391–392.


---

*Aluminum sheath* for telephone cables, to supplement the familiar lead-covered cable, is a thin sheet of the metal covered with rubber-like flexible black plastic. It will be made in sizes ranging from small cables to those containing hundreds of pairs of wires.

# TODAY'S SCIENCE AND OUR BASIC PHILOSOPHIES*

PERCY L. JULIAN
*The Glidden Company, Chicago, Illinois*

It was said of the great Michael Faraday that he added to the powers of his intellect all of the graces of the human heart. No more appropriate challenge and no nobler resolve could commend themselves to a fraternity of scientists in this crucial hour in world history. For membership in this great fraternity is indeed a dubious honor if the yardstick be only what the scientist *does* and not what he *is*. Before Hiroshima we were looked upon as the benefactors of mankind. The material fruits of the Renaissance of the past two decades in organic and biological chemistry, embracing the syntheses of all of the major vitamins, many of the glandular secretions and the microbiological syntheses of the antibiotics; the combined advances in electronics and mechanics; the elucidation of metabolic processes and the concomitant abbreviation of human suffering—all of these had obscured our larger visions in a blessed fog of physical comfort and material well-being.

Without warning the monster dropped upon Hiroshima. John Hersey tells us that of the 150 physicians laboring among the sick in that village of human beings, 65 were killed and the remainder wounded beyond repair. Of 1,780 nurses, 1,654 were dead or too badly hurt to carry on. Each bomb dropped killed 68,000 people and injured another 90,000 and several were dropped. The wildest nightmares of the imagination can hardly conjure up the horror of this mass murder. Add to this bright gift of the scientist to humanity the winged machines which pour death upon thousands of innocently sleeping youngsters at Pearl Harbor; add to his assets of cultural development the gas killings and tortures at Dachau and Buchenwald, and for dessert at this banquet of cultural excellence crown the feast of pride with the germ bombs now being fashioned in Washington, composed of the most deadly bacteria which will unleash the plague of miserable death upon every living thing that populates the earth it strikes. Add these up and you have the tragically ironic truth that the pursuit of truth has at last led us to the tools by which we can ourselves become the destroyers of all our own temples of culture and all the bright hopes of the human race. Indeed, my friends, it is a dubious honor to be counted among the contributors of these fiendish creations. But *are* they the scientist's creations? Is his the responsibility for senseless murder any more than the steel manufac-

* An address delivered to the Central Association of Sciedce and Mathematics Teachers, Edgewater Beach Hotel, 11-28-47.

turer is responsible for the death of a child who slashes its throat with its father's shaving razor? Are the cultural assets of the ages such thin veneer that we are like little children who cannot be trusted with the fruits of Truth?

Neither scientist nor saint dares deceive himself as to the naked ugliness of the age in which we live. Since Pearl Harbor we have been writing some of the blackest and most disgraceful pages in the history of mankind. Did I say Pearl Harbor? I correct that. Since the rape of Ethiopia with our American complacent indulgence and since Hitler launched his campaign of systematic murder against Jews with our isolationist shrug of the shoulder, history has slowly swung its pendulum back to the centuries following the Black Plague and the Hundred Years War. For what are Jews to us Americans even in this crucial hour in world history after the direst suffering on their part and most colossal mass murder of them history has witnessed for humanity in three centuries? A *Fortune* magazine poll of public opinion last month tells us what Jews are to the masses of Americans. According to that poll, 36% of America's population have deep resentment against Jews because of what they imagine to be Jewish economic power and 21% think Jews have too much "political power." In short one American out of every two is obsessed with the hatred against one segment of his fellowmen. And we feebly try to stand as champions of and leaders to a just and durable peace for mankind. Where is our vaunted American Faith in Life, Liberty and The Pursuit of Happiness for all mankind? Where are the graces of the human heart?

In this arena of confusion, in the midst of this totality of utter stupidity, in a world where the individual perception of values has sunk so low that morality in a broad sense has almost ceased to have meaning—the scientist stands dazed, with strange and wondering eyes. Down the weary pages of history he turns his gaze and sees the birth of Modern Science following close on the heels of the great Italian Renaissance that shook humanity out of its lethargy and spiritual degradation. He sees with a shock that his effort to enlarge the vision of man with the X-Ray and the microscope; his efforts to expand the strength of his voice through wireless telegraphy; his labor to increase the sensitivity of man's hearing through radio and telephone; his effort to lift the burden of the ages from the backs of men, with cranes, derricks and machines, born of the sufferings and saint-like patience of a Michael Faraday—he sees with a shock that all these efforts have not revealed to mankind a world of reality—the emphasis in man's mind during all this dreaming and creation of modern science has not been on the enlargement of vision but on the X-Ray itself, not in knowing his neighbor through ability to talk

with him over miles of expanse but on the telephone and telegraph itself. The emphasis has not been on order, beauty, symphony, harmony, which must prevail in human society even as they pervade the society of Nature, but merely on the harnessing of nature's forces themselves. These discarded emphases constitute the world of reality. They make up the Eternal Verities. What man, however, has seen in Modern Science has been *only* a world of senses, only what he can taste, feel, smell and hear—a world of appearance.

To such a man, Modern Science has meant only the donation of material things and as these gifts of material things by the scientist's labors have increased and varied the lust for the possession of them has become the dominant obsession of the age. Thus modern science has been defined not in terms of what it *is*, but of what it *does*, as interpreted by the pragmatic judgment of the primitive intellect. It is such a world which *Fortune* magazine accurately pictures in a hatred of Jews for what it is imagined they possess of material things. In such a world the devotee of modern science sees with a shock that the peace of the forest, the magnificence of the heavens, the magnetic beauty of the sparkling dewdrop and the wonder of the order and harmony of the physical world—these inpiring verities of the scientist do not "probe beneath the calloused husk that hides the better selves of men."

Now what is our solemn duty in these days of confusion, when the revelation of the very expansiveness of the Creation has brought man to a loss of his moorings, when the shifting sands of fear and uncertainty have replaced the solid rock of Eternal Verities? What is our challenge—we who on the one hand belong to that quiet and profound business of original investigation, and we who engage in that more vocal but noble business of translating the fruit of these labors into basic philosophies for a new generation?

To begin with we must face our own inadequacies with stern honesty. I am afraid that in the sincerity of humility we Americans must admit that we have epitomized the development of this "calloused husk" that unconsciously extols the possession of material things as the motivating concept of 20th century behavior. And herein lies the "American Dilemma" expressed in a broader vein. Our country is called upon in this hour to give to the world an *example* and not a *doctrine* of human behavior. Suffering humanity is sick of doctrine. And what examples do we offer?

1. The greatest concern of our people over starving Europe is that if we are forced to give too much away, our standard of living might be impaired. So dominating is this fear for the preservation of our radios and automobiles that we call it the feeble voice of "faith

healers" and any man in public life who dares remind us that we are our "brother's keeper." And few men in public life dare risk their futures by indulging in such star gazing. Thus American public morality has sunk into a morass of confusion that makes our solicitude for world well-being only a fear for the safety of our own skins. Truly does it smack of "double talk."

2. We would rather risk a bloody war between Arabs and Jews than admit 100,000 homeless Jews to the broad expanses of this country. The *Fortune* magazine poll indicates that our solicitude for the poor victims of Hitler is but lip service to our American faith. What we actually are concerned with is their possible threat to our individual economic holdings.

3. We would rather see our veterans and their children sleep in parks or in the disgraceful shacks that we have been forced to erect temporarily than to have one of them build a $10,000 home next to our $35,000 place and thus detract from the financial value of our neighborhood. Where are our promises to these defenders of our faith? Gone with the dominant obsession of 20th century America!

4. We are waging a bitter battle at this moment—to uphold the divine right of *Restrictive Covenants*, a vicious system of quasi-legal agreements that have (a) created the most tragic ghettos recorded in human history, (b) increased the incidence of disease, crime and juvenile delinquency, (c) relegated 14,000,000 of proud people to a special class of despised untouchables, (d) leveled down the hopes, ambitions and achievements of 14,000,000 of people to a lowest common denominator and (e) sowed the seeds of distrust, hatred and spiritual degradation which are destined to plague us for centuries to come. The Supreme Court of the United States is now about to sit in solemn judgment on this question. What is the most powerful public appeal which the real estate lobbying has to aid him in enforcing these restrictive covenants? It is the simple one that "if a negro moves into your neighborhood the value of your property goes down." Thus the dominating obsession of the age has become the most powerful weapon for disseminating racial and religious hatred.

The world has long thought and hoped that American Faith represented the dawning—even if feeble—vision of the dignity of the human personality. What a shock that when sick humanity needs that faith as a burning example of justice, amity and good will, as a beacon light to a just and durable world peace—what a tragedy that it becomes merely a doctrine!

With the sincerity of purveyers of Truth it seems to me that we must recognize this background in shaping the basic philosophies of a new generation. First of all not what the scientist does but what he is must

be the dominating motivation of our teaching, whether it be the teaching of research methods or the interpretations of elementary facts and principles.

And secondly, he is no good teacher of science and mathematics who does not formulate the concept of one world out of the pages of history. That Michael Faraday drew a living spark from the lifeless magnet while Agassiz in Italy rode down the Alps upon the backs of the glaciers and proved their steady flow; that Daniel, Grove and Bunsen inspired by Faraday's genius, gave us an enduring source of electrodynamic power, while Ohm in Germany taught us to measure such a power when obtained; that Bessel detected the parallaxes of the fixed stars, while Adams and Leverrier threw their grapples out into space and felt the influence of an unseen planet, Jupiter, trembling along the lines of their analyses; that Stokes stood one afternoon in the green English countryside and gazed at a rainbow, and as he looked from the red to the violet end he wondered what became of yonder violet as it faded into the invisible, and lo—with this dream had Stokes discovered for us the ultra violet (beyond the violet) and blessed us unwittingly with Vitamin D, the sunshine vitamin, so that today our children need not grow up with the crooked bones of rickets, so that today we have struck deep at the heart of arthritis and rheumatism, and so that today a hen that used to lay you 150 eggs a year now lays you 250 eggs a year with DuPont's "Delsterol." That all these good things were possible because men of vision dared to dream of better things in the days yet to come.

That Edison in our own country discovered that hot bodies give off electricity and that Roentgen in far-off Germany placed a piece of metal in the path of such electricity and thereby enlarged our vision with the X-Ray enabling our eye to see where hitherto we had not dreamed it would; that Mendelief, a poor lad in distant Russia struggled up through the university and out of the brilliance of his intellect, harnessed the wayward masses of the atoms into a system of periodicity, leaving a blank space which one day uranium was to fill; that one day Becquerel, in France, filled that space, and Poland sent a daughter of genius to France to start us on the search for its hidden power—how poor indeed our lives would be but for these gifts from peoples from the far-flung corners of "One World."

Truly can it be said that the teaching of science in this day is a sacred mission, for if the vision of mankind is to be enlarged so as to see that the search for Truth is synonymous with the search for goodness, you and I must provide the soil in which such dawning visions can blossom and flourish. If, for example, it were formerly merely poor pedagogy to write into our laboratory manuals "add a few drops of potassium dichromate and note the green color," it becomes today

a distinct crime to deny to the student in this way the use of his own vision for the cultivation of that insight so essential to the preservation of our culture. Similarly the type of objective test which saves your time by concentration upon the answer rather than the formulation can be the cruelest disservice to your proud profession.

And finally what further comfort can you and I as scientists bring to those under our tutelage? We can sear into the souls of our students the conviction that the true scientist lives for eternity and must live in eternity. Like my forefathers he builds a structure he may never enjoy but which will, as surely as the stream dwindles when the spring dies, enrich human living when the springs of tawdry and primitive materialism have run their course. And so living he can look unperturbed down the ages of history.

We live in an age of fruitful Renaissance. We are now enjoying a revelation of the expansiveness of the creations such as history has never recorded. In just such an age Modern Science had its birth. That age of the Italian Renaissance was beclouded by a loss of Faith on the part of men. Expanding knowledge conjured up in the minds of men a belief in magic. Witchcraft arose with as little apparent fundamental reason as the present Godlessness which grips us. The disgraceful witch hunting and mass murder which followed find their slightly more veiled complement in the present Communist baiting and hysteria of this day. Man needed in the seventeenth and early eighteenth centuries the kindling of Faith in his ability to master Nature. Man suffered from fear of witches lurking in the dark to strike down their helpless victims. Senseless mass hysteria gripped the minds of men, palsy fear retarded reason. In this hour of confusion Galileo, daring death to bring to men the courage of conviction, and Newton facing ridicule to place the harness of universal gravitation upon the wayward movement of the shooting stars—these stalwarts ushered in the era of Modern Science.

Today the limits of man's mastery over Nature are clearly defined. Man's mastery over man is the dominant question. Our feeble mentalities, the vistas of which have been slow to widen must make ready to take another great hurdle. Not the inexorable justice of primitive Nature but the harmony of Nature truly revealed must grip the hearts of men as a pattern of social behavior. The curse which Modern Science has brought to humanity with the Atomic Bomb may yet prove to be the blessing which will enable man to realize with John Bunyan that "we are but creatures stumbling and falling together on our journey to God"—to the God of Harmony and of Peace, to the God of Justice and of Mercy. And we either stumble *together* or humanity will perish from the earth.

# NOTES FROM A MATHEMATICS CLASSROOM

JOSEPH A. NYBERG
*Hyde Park High School, Chicago*

**149. Irrational Binominal Denominators.** Where in our courses in algebra should we teach an operation that is not used until we reach trigonometry or solid geometry? In *Odd Numbers*, page 143, by *Herbert McKay* (Macmillan Co., London, 1940) the author refers to a fraction whose denominator is $\sqrt{3}-\sqrt{2}$, and states that amongst many thousands of problems he has not come across one where the process of rationalizing a denominator was needed, apart from exercises devised to teach the process.

As often happens, if our attention is once forcibly directed to some configuration we thereafter observe examples of it that would otherwise pass unnoticed. After reading McKay's statement it seemed that irrational denominators confronted me in every class.

The class in solid geometry derived the formula for the volume of a frustum of a cone and found $\sqrt{b}-\sqrt{b'}$ in a denominator.

One of the extra credit problems for the day was:

The radius of the base of a cone is $r$ and its altitude is $h$. Find the side of the cube inscribed in the cone.

The answer is

$$\frac{rh\sqrt{2}}{h+r\sqrt{2}}.$$

The trigonometry class solved the problem:

At a point $a$ feet above the level of a pond the angle of elevation of a tree on the opposite side is 45°, and the angle of depression of the reflection of its top is 60°. Find the height of the tree.

The answer is

$$\frac{a(\sqrt{3}+1)}{\sqrt{3}-1}.$$

Another problem was:

From the foot of a post the angle of elevation of the top of a steeple is 45°. From the top of the post, which is 40 ft. high, the angle of elevation of the top of the steeple is 30°. Find the height of the steeple.

The answer is

$$\frac{120}{3-\sqrt{3}}.$$

In geometry class an extra credit problem (taken from a College Entrance Examination of twenty years ago) was:

One arm of a right triangle is 2 in., and the opposite angle is 30°. How far is the point of intersection of the bisectors of the angles from the given arm?

The answer is

$$\frac{2}{1+\sqrt{3}}.$$

A really practical problem (for an architect) is:

In an equilateral triangle three equal circles are drawn, each tangent to the other two circles and also tangent to two sides of the triangle. If a side of the triangle is $a$, show that the radii of the circles are

$$\frac{a}{2(1+\sqrt{3})}.$$

Evidently binomial irrational denominators are not quite so scarce as McKay imagines. Rationalizing the denominator by multiplying by the conjugate should be studied in the third semester of algebra. When such fractions arise in trigonometry and solid geometry most of the pupils will naturally have forgotten the operation and ten minutes of review will be needed to refresh the memory. Much of intermediate algebra (the third semester of algebra) consists of odds and ends of algebraic techniques that have few immediate applications. We cannot postpone all operations until they can be applied. We cannot postpone planting seed until we are hungry. Although the problems I have mentioned may not be part of a minimum course, neither is intermediate algebra a part of a minimum education for minimum citizens.

**150. When To Begin Linear Equations.** Last month I called attention to certain dangers if signed numbers are not treated early in the beginning course in algebra. Much time and energy is wasted if any topic is treated once using only positive numbers, and then rehashed after negative numbers have been introduced. An even greater waste may result if equations are treated before the chapter on signed numbers and then rehashed and extended after that chapter.

It is true that in the introductory work (covering approximately two weeks) some use should be made of equations. Thus we may learn that a mathematician uses $3x=12$ as a way of saying that 3 times an unknown number is 12. But such problems should be used sparingly or the pupil will say that he could find that unknown number without using any equation, and the pupil will think that algebra is merely arithmetic done in a harder way. For this introductory work the three cases of percentage problems, and problems based on percent of growth, profit and loss, commissions, and mark-ups in business

are useful. But even here the emphasis should be on the fact that equations offer a simple way of writing a relationship—the finding of the unknown being less important at that time.

After this introductory work we may as well learn how to add, multiply, and divide signed numbers. Further, this work should be limited to numbers like $-5$, $+6$, $-7$, $+\frac{1}{4}$, $-\frac{2}{3}$, and should not be extended to the corresponding operations with algebraic polynomials. We should limit the work to those ideas which are needed to solve equations, and certainly adding $6x^2+7x-3$ to $-3x^2-4x+9$ is not needed as a preparation for solving equations. In my experience, five days are enough for learning the operations with signed numbers. The pupil need not drill until he has reached 100 percent accuracy, or even 90 percent, or 80 percent.

A thorough study of equations is next on the program, beginning with equations like $6x=-24$ and proceeding to the types $5x-3=8$, $7x=18-2x$, $-5x=9x-42$, $3-(4x+7)=5x$, $5(x-3)=2x$ and so forth. Note that in solving the equations and checking the answers, the pupil will get the additional drill with signed numbers that will raise the 80 percent of accuracy in the work of the previous unit.

This procedure is based on the notion that algebra, like all mathematics is concerned with the solution of problems and that we solve problems by means of equations. Hence the beginning of algebra should concern itself chiefly with solving equations, and we should teach *early* whatever is needed to solve equations. The procedure that I dislike first studies addition and then applies addition to signed numbers, then to algebraic polynomials, and then to equations (to illustrate, supposedly, an application of addition). Next it studies multiplication of signed numbers, of monomials, of polynomials, and finally studies equations that involve multiplications (again, supposedly, to illustrate an application of multiplication). Such procedures emphasize the *operations*, and treat equations as incidental by-products. I prefer to emphasize the equations and to treat the operations as unavoidable tools.

The early treatment of signed numbers avoids the necessity of having two separate units dealing with equations. It also has other advantages. One advantage is that embarrassing situations in class are often avoided. For a simple example, consider the problem which states that a piece of wire 20 in. long is to be cut in two pieces, one of them 2 in. longer than the other. If a pupil represents the pieces by $x$ and $x+2$, the work will proceed smoothly. But suppose some pupil represents the pieces by $x$ and $x-2$. If negative numbers have been studied, this change causes slight comment. Otherwise, extensive supplementary discussions are unavoidable. The innocent looking problem "The sum of two numbers is 10; 5 times one of them is 2 more

than 7 times the other" can lead to

$$5(10-x)=7x+2.$$

But if some pupil writes $5x-7(10-x)=2$ the work of reconciling the solutions is a decided interruption. If signed numbers have been studied, the pupil can do his own reconciling without interrupting the class.

A more important reason, however, is that the suggested treatment of signed numbers and equations permits the early consideration of more significant verbal problems. If trivial problems, in which the unknowns are $x$ and $2x$, or $x$ and $x+3$, and which lead to equations no more difficult than $x+2x=18$ or $x+x+3=39$ get too much attention, there will be less time to study problems about rates, distances, mixtures, and so forth. Such problems need to be started early so that they can be treated periodically, in October, and in November, and in December, with frequent reviews and much reteaching.

The suggested procedure is also a great saver of time.

**151. Comparing Areas and Circumferences.** The unit on areas and circumferences of circles need not limit itself to problems on computations. The following experiment is much enjoyed by pupils. On a sheet of paper draw three concentric circles, the second having 3 times the area of the first, and the third having 3 times the circumference of the first. The circles are numbered 1, 2, and 3. On the paper write these questions:

Which circle is 3 times as large in area as the smallest circle?

For which circle is the circumference 3 times as long as the circumference of the smallest circle?

In the manner of the *Gallup* poll each pupil presents his drawing and the questions to a number of people—parents, relatives, bus drivers, janitors, grocers, or butchers, aiming to get at least ten interviews.

The experiment has been tried many years. I have not totaled the results but I have a definite impression that the answers are about ninety percent wrong. A few correct answers come from fathers who are engineers or scientists, and from garage mechanics and machinists. When the questions are phrased "Which circle is 9 times as large as the smallest, and which is 3 times the smallest?" and when the questions both refer to the circumferences, the answers are about 100 percent right, as we might expect. All of which shows that the untrained mind confuses areas and circumferences.

---

Educational neglect caused Selective Service in World War II to reject the equivalent of 20 combat divisions, almost as many combat divisions as were deployed in the entire Pacific area during the war.

## SCIENCE LEGISLATION
## NATIONAL SCIENCE FOUNDATION BILLS

(*Continued from March*)

(Compiled by ELEANOR JOHNSON)

Summary of statement submitted by George E. Folk, Special Advisor to the National Association of Manufacturers' Committee on Patents and Research. From—U. S. Cong. 80th, 1st sess. House. Committee on Interstate and Foreign Commerce. Hearings, on H.R. 942, H.R. 1815, H.R. 1830, H.R. 1834, and H.R. 2027. National Science Foundation. p. 126–135. Mar. 6, 1947.

The N.A.M. favors in principle legislation for creating a National Science Foundation along the lines recommended by Dr. Vannevar Bush in his report entitled "Science, the Endless Frontier." It believes that the Foundation should have certain characteristics found in the four identical bills, H.R. 1815, H.R. 1830, 1834, and 2027. There are certain provisions of these four bills which are open to adverse criticism. Turning now to the Celler bill, H.R. 942, which is identical with the Kilgore bill, S. 1850, of the 79th Congress, introduced on February 21, 1946, the National Association of Manufacturers cannot view H.R. 942 with approval since it departs to such an extent from the original concepts of what was deemed necessary to carry out the fine objectives of Dr. Vannevar Bush. The reasons for approving certain features and disapproving others, as above enumerated, are set forth in the main statement.

Jewett opposes National Science Foundation. *N. Y. Times, Oct. 20, 1945, p. 26.*

Federal support of postwar science and development through existing agencies in preference to the creation of a Federal Research Foundation was urged by Frank B. Jewett, president of the National Academy of Sciences. Mr. Jewett said that the case for Federal support of fundamental science research "with all the restraints inevitable with such support" seemed to him exceptionally weak.

From—U. S. Cong. 80th, 1st sess. House. Committee on Interstate and Foreign Commerce. Hearings on H.R. 942, H.R. 1815, H.R. 1834, and H.R. 2027. National Science Foundation. p. 73–96.

Frank B. Jewett advised in his testimony against any Foundation. He said that present shortage of private funds for fundamental research in the sciences was only temporary, due to the existing tax structure, and that he thought that a small change in the tax laws would make private funds again available in sufficient amounts. (In taking a position against the Foundation he continued his stand of a year ago in the Senate hearings as the only person to testify against some form of Federal subsidy for research.) March 6, 1947.

Compton urges Science Foundation. *Chemical and Engineering News, vol. 25, Mar. 17, 1947, p. 765.*

Federal government aid through the National Science Foundation is the logical answer to increased fundamental research. This was the theme of the address of Karl T. Compton, President of M.I.T. in accepting the Washington Award presented by the Western Society of Engineers and cooperating societies in Chicago, Feb. 26.

A National Science Foundation? If so, what? *Chemical and Engineering News, vol. 25, Mar. 17, 1947, p. 773–775.*

Letters written to C & EN in response to their request to their readers to submit their views on this subject. Letter from R. L. Meier of University of California, gives in detail the poll taken by the Northern California Association of Scientists. This group was very strongly in favor of a science foundation, 2 to 1 in favor of bill patterned after S. 1850 over H.R. 6448, and preponderantly in favor of including some patent provisions, and inclusion of the social sciences.

A National Science Foundation, by Will C. Foster. *Science, vol. 105, Mar. 21, 1947, p. 297–299.*

Undersecretary of Commerce discusses the controversial issues of administration, patent policy, social sciences, and distribution of funds. Advocates the combination of single administrator and advisory board of H.R. 942 (former S. 1850). Inclusion of social sciences, the formula for distribution of funds in H.R. 942 appealed to him. (25 per cent allocated to land grant colleges and state universities, 15 per cent in proportion to population of each state, and 10 per cent in equal shares to all states, and 25 per cent earmarked for non-profit institutions. The patent problem is a separate issue and should be considered independently.

A National Science Foundation. Statement by James B. Conant. *Science, vol. 105, Mar. 31, 1947, p. 297–299.*
Confined remarks to undergraduate scholarship program. No use to consider ways and means of spending money on research unless first-rate men are available to do the work. Recommends a plan similar to Holloway plan for N.R.O.T.C. Should award scholarships in such manner as to make a wide distribution among the states. At present our research scientists are drawn in a large measure from relatively few states. This is not a healthy situation. A Federal program of scholarships would change this. Trial of such a program for five or six years would convince Congress and the American people of the worth of this plan.

A National Science Foundation. Statement by Vannevar Bush. *Science, vol. 105, Mar. 21, 1947, p. 302–305.*
A commission or board as a group should not be directly active in the actual operations of the Foundation. There is no reason why this should occur in the organization as outlined by bill H.R. 1830. Organization would be similar to the very effective National Advisory Committee for Aeronautics. Much agreement that the Foundation should be free from politics. This argument valid only in the sense that it should be free from the pressure of any special interests whatever. It is a government agency, and as such should be directly responsible to the people, and more directly to Congress.

A National Science Foundation? If so, what? *Chemical and Engineering News vol. 25, Mar. 24, 1947, p. 843–845.*
More letters expressing various viewpoints and making suggestions on national science foundation legislation.

During the week past the Inter-Society Committee for a National Science Foundation announced the results of a survey of the representatives of the 70 odd scientific and educational organizations that constitute its membership . . . *Science, vol. 105, Mar. 28, 1947, p. 329.*
Two-thirds of group favored a single administrator. 18 per cent favored a commission type. 98 per cent favored inclusion of social sciences, 86 per cent favored the inclusion of undergraduate scholarships and 94 per cent believed that no special stand should be taken on the patent issue.

The Conference of representatives of about a hundred American Scientific societies in Washington on Feb. 23, brought about a hopeful renewal of action toward the establishment of a National Science Foundation . . . *Science, vol. 105, Mar. 28, 1947, p. 333.*
Unlikely that such a bill would be enacted by a Congress primarily interested in economy, however, unless concerted action and pressure from voters "back home" demanded it. Scientists must recognize this fact and take organized action to inform the American voter.

A National Science Foundation? If so, what? *Chemical and Engineering News, vol. 25, Mar. 31, 1947, p. 907–908.*
Concluding set of letters on national science foundation.

Inter-Society Committee for a National Science Foundation. *Chemical and Engineering News, vol. 25, April 7, 1947, p. 972.*

Releases results of questionnaire and lists organizations which are reported as members of the Inter-Society Committee.

Potomoc Postscripts. Al Leggin. *Chemical and Engineering News, vol. 25, April 14, 1947, p. 1025.*
S. 526 reported out to Senate by Labor and Public Welfare Committee, with several minor amendments.

The Senate Committee on Labor and Public Welfare has reported favorably on National Science Foundation Bill S. 526 . . . *Science, vol. 105, April 18, 1947, p. 407.*
Recommended with major amendments as listed.

National Science Foundation. *Chemical and Engineering News, vol. 25, May 5, 1947, p. 1308.*
Board of Directors of ACS at meeting in Atlantic City endorsed National Science Foundation bill S. 526. Pretty general agreement among scientists that S. 526 is satisfactory.

The Senate passed the National Science Foundation bill on May 20, 1947. *Science, vol. 105, May 30, 1947, p. 569.*
Bill passed was essentially S. 526 with two major amendments. (1) 25 per cent of funds will be distributed to tax supported and land grant colleges (2) Director to be appointed by President instead of Executive Committee of Foundation.

Senate passes National Science Foundation bill. Al Leggin. *Chemical and Engineering News, vol. 25, June 2, 1947, p. 1577–1578.*
After five days of debate the Senate overwhelmingly passed S. 526. Although this vote indicated that the Senate was entirely in favor of the establishment of the Foundation, there was considerable disagreement as to the type of organization and the method of operation. Discussion of amendments, both those passed and those rejected is given, as well as the text of the Morse amendment, that which related to the mandatory distribution of funds by states, and also the complete text of S. 526 as passed by the Senate.

A National Science Foundation bill, H.R. 4102 introduced into the House, by Rep. Wolverton of New Jersey on July 7 . . . *Science, vol. 106, July 18, 1947, p. 58.*
Reported out by Committee on Interstate and Foreign Commerce. This bill carried essentially the same provision as S. 526. Stipulates the Director shall be appointed by the Foundation of 24 members. Omits special mention of social sciences, and allotment of research funds. Patent provisions limits employees of Foundation from obtaining patents on any inventions resulting from their activities with the Foundation.

Potomac Postscripts. Al Leggin. *Chemical and Engineering News, vol. 25, July 21, 1947, p. 2063.*
House Foreign and Interstate Commerce Committee reports a new science foundation bill H.R. 4102 and shelves S. 526. This measure is similar but omits controversial provisions. Legislation now has a political as well as an academic significance. Rumors about Washington imply that the President will veto the legislation.

National Science Foundation legislation was, at the beginning of this week in the hands of conferees from both the House and Senate in order that a compromise might be reached on such issues as appointment of a Director. *Science, vol. 106, July 25, 1947, p. 78.*

Potomac Postscripts. Al Leggin. *Chemical and Engineering News, vol. 25, July 28, 1947, p. 2127.*
House passes Science Foundation bill H.R. 4102. Joint conference committee

to study difference in provisions for single distribution of funds and appointment of director. Although H.R. 4102 was passed by the House, it will not be the Science Foundation Bill. At the conclusion of the vote, Representative Wolverton requested that S. 526 be considered and amended to contain the provisions of H.R. 4102. The amendment was passed and S. 526 as amended by the House went to a conference committee for an agreement on difference between House and Senate versions.

Laboratories and Colleges in military hands. *Christian Century, vol. 64, July 30, 1947, p. 917.*
One of the bills in Congress is the National Science Foundation bill. It is designed to carry on scientific research started by the OSRD. With millions to distribute each year it will be astonishing if the new body does not soon hold almost dictatorial powers over what goes on in America's scientific faculties and laboratories. No one denies need for trained scientific personnel, but if, as its size and other responsibilities of its distinguished membership make almost certain, the new Foundation has to turn most of its actual functioning over to a small working committee of some sort, the powers of that committee to affect the character of American education will be tremendously great. Washington reports say this committee will be heavily loaded with representatives of the armed forces. Danger lies in the growth of habitual recourse, on the part of colleges, to a military-minded branch of the government for funds.

Potomac Postscripts. Al Leggin. *Chemical and Engineering News, vol. 25, Aug. 4, 1947, p. 2191.*
Science Foundation Bill, S. 526 passed by Congress. Provisions for state distribution of funds omitted. Full text of bill as passed given.

The Ivy League Lobby. *New Republic, vol. 117, Aug. 4, 1947, p. 10.*
National Science Foundation Act of 1947 was a triumph of the Ivy League Lobby. Act was designed to tighten the grip on government research money already held by Vannevar Bush, OSRD, Karl T. Compton, and James B. Conant of Harvard. Liberal opposition rested on three reasons: (1) these men are all close to the military and can be counted on to take reactionary militarist stand on any question. (2) All physical scientists look on social science as a sort of pinkish boon-doggle. (3) They represent a handful of biggest and richest educational institutions, which get all best governmental plums. Last year when an Administration bill was up, Dr. Bush did all he could in private to kill it. The bill contained 3 basic points the Administration wished to see enacted in law (1) Provisions for social as well as physical sciences. (2) Direct government control. (3) Uniform patent provisions to protect equity in Federally supported research. This bill (S. 526) was Dr. Bush's dish, complicated organization would leave President and the government with no control, and assure domination of the Bush clique.

The National Science Foundation bill, after having been passed by both the House and Senate was vetoed by President Truman on August 6. At the same time the President urged that Congress, when it reconvenes in Jan. reconsider and pass an acceptable bill. The veto message stated that the bill implied "A distinct lack of faith in the democratic process" and in effect would "vest the determination of vital national policies, the expenditures of large public funds and the administration of important governmental functions in a group of individuals who would be essentially private citizens." "Full governmental authority and responsibility would be placed in 24 part time officers whom the President could not effectively hold responsible for proper administration." Watson Davis director of Science Service, in a release, dated Aug. 7, has aptly commented: "Scientists in all fields are disappointed that the bill did not become a law. Some of them point out that control of research funds available for grants are left by default, in the hands of the Army, Navy and Air Forces . . . they want to see research predominantly in civilian hands, and the military

research bureaus have agreed with them. *Science, vol. 106, August 14, 1947*, p. 106.

Research support blocked by veto. Watson Davis. *Science News Letter, vol. 52, Aug. 16, 1947, p. 99.*

The veto postpones full-scale government support of basic scientific research for at least six months, probably two years, and maybe longer. Scientists in all fields are disappointed. Some point out that control of research funds are left by default, largely in the hands of Army, Navy and air forces. Scholarship and fellowship appropriations in the vetoed bill, considered one of the bill's most important features, are now delayed. Truman objection was that the complex organization violated the basic principles which make for responsible government. Dr. Detlev W. Bront, of the National Research Council said that regrettable differences of opinion between legislative and executive branches as to organization barred the creation of a National Science Foundation. The need is great, and scientists hope that legislation will be passed in the next session which will satisfy both. Senator Smith said "Regrettable that President Truman has made a 'political football' of what undoubtedly would have been the greatest contribution made in this country by any Congress since the turn of the century." Karl T. Compton, "Veto is disappointing, and ill-advised."

Potomac Postscripts. Al Leggin. *Chemical and Engineering News, vol. 25, Aug. 18, 1947, p. 2347.*

President Truman vetoes science foundation bill. Declares provisions of the legislation are unsound and undemocratic. Objections exclusively on the administrative set-up.

Challenge of the National Science Foundation. *School and Society, vol. 66, Aug. 30, 1947, p. 150–151.*

Bill vetoed by Truman was because of other than form of organization reasons. It marked failure to recognize the important place of humanities and social sciences in the nation's culture. Marked failure on part of educators to impress country with value of social sciences and humanities. The conflict between academic subjects and practical subjects is not new. Colleges and universities have an obligation imposed on them by the challenge of the governmental support of sciences, to see to it that the gains of the last decade in favor of a balanced program of education are not lost.

The Truman veto. Howard A. Meyerhoff. *Science, vol. 106, Sept. 12, 1947. p. 236–237.*

Meyerhoff urges scientists to analyze the situation before condemning the President. The vetoed Smith bill S. 526 was essentially the early Magnuson bill, with a few concessions. Or rather, in the main, it is the Bush bill, as it was based on the Bush report "Science, the Endless Frontier." In 1946 the Administration made it perfectly clear that it would never enact such a bill. In the face of the President's forthright statements, S. 526 was drafted and passed. Little regard was paid to carefully considered recommendations of the Inter-Society Committee sponsored by the AAAS. The Administrative structure of the Foundation would have concentrated too much power in the hands of too few, without a single effective control from scientists, the Congress, or President. The manner in which the bill was maneuvered through Congress by a small group gives basis for this argument. Senate has shown willingness to pass science foundation legislation, and it now needs the advice of representatives of science and not a partisan point of view. It is now time for the leaders of the Inter-Society Committee to take over and act.

Since many scientists will not have seen the complete text of President Truman's memorandum of disapproval of S. 526 . . . *Science, vol. 106, Sept. 12, 1947, p. 237–239.*

Text of veto message.

Atomic bombs or atomic plenty. Leonard Engel. ***Nation, vol. 165, Sept. 20, 1947, p. 275–277.***
President Truman blundered in vetoing the National Science Foundation bill, on basis that unusual administrative set-up was unsound and possibly unconstitutional. Every day without a National Science Foundation is a national calamity. U. S. is suffering from a deficiency of trained scientific personnel, and an extensive federal scholarship program was a part of the vetoed bill. Lack of civilian National Science Foundation is giving control of basic or "pure" scientific research and the most important type of scientific work, to the Army and Navy. No greater evil imaginable than military control of scientific research. Army and Navy at the moment do not have a firm control on basic scientific research, but bit by bit control is slipping from its traditional academic guardian. While it will not solve all problems, a civilian National Science Foundation will at least put the direction of scientific research back where it belongs, firmly in the hands of civilian scientists.

The National Science Foundation Bill and the President's veto. ***Bulletin of the Atomic Scientists, vol. 3, October 1947, p. 290.***
Lengthy summary of the bill, the President's veto.

The Deficiencies of the National Science Foundation bill. ***Bulletin of the Atomic Scientists, vol. 3, October, 1947, p. 291–296.***
Veto was a necessary step in the creation of a satisfactory agency. Organization chief issue in legislation. S. 526 deprives president of essential powers, invited academic log-rolling, and the bill itself lacked coherence. Previous bills set-up a more workable organization. The compromise made in S. 1850 seemed to effect a happy solution. In this a single administrator was appointed by the President, but as advisory board was given enough status to insure it a measure of control. or at least substantial influence, over policy. Three reasons advanced in favor of a part-time board, rather than a single administrator were (1) the best men won't work full time for the government; (2) science must not be regimented, for basic research cannot be planned and regimented as were wartime developments; and (3) science must be protected from political interference. All arguments contain a large measure of truth, but even so they are not very relevant to the problem of organizing a National Science Foundation. Jobs to be done by government would be most challenging in our society, and this would no doubt attract competent personnel. Only sustained policy can protect freedom of research, and this might well be done better by a full-time administrator, who could not be charged with having interests of private institutions, which he would also be representing, at heart. The prevention of political interference would be less likely if the President were held responsible for carrying out the general program.

Potomac Postscripts. Al Leggin. ***Chemical and Engineering News, vol. 25, Nov. 10, 1947, p. 3271.***
National science foundation legislation is again being seriously considered by both Houses of Congress. The report of the President's Scientific Research Board "Science and the Public Policy" outlines the President's desires for such a Foundation. The report stated that the Foundation should be located within the Executive Department, and the director and board of the Foundation should be appointed by the President. It also recommended that half of the members of the board be drawn from the personnel of government agencies with a major role in scientific research, and half from among scientists and educators outside of the government. A . . . basic change from the former legislation is that grants for scholarships to science students not be included in the responsibilities of the Foundation. Reliable sources indicate that one of the leading sponsors for S. 526 will introduce a similar bill early in the next session to avoid a pocket veto. It is understood that the new bill will provide that the director be appointed by the President, and also for a pro rata division of funds among the states. The measure

will undoubtedly become a political argument next fall, and passage of the bill will depend on the whims of the politicians and not the desires of the scientists. . . . However in the Report of the President's Scientific Research Board, "Science and the Public Policy," vol. 4, p. 141, it states explicitly:

"It is recommended that a scholarship program be initiated immediately, based upon evidence such as was presented in the Bush report. We also recommend further study of such a program to provide additional financial aid wherever needed to maintain able students in the colleges and the graduate schools. Available private funds are limited and such financial assistance must be obtained from Federal funds."

---

## THE MATHEMATICS INSTITUTE AT DUKE UNIVERSITY

VERYL SCHULT
*Director of Mathematics, Divs. 1–9, Washington, D. C.*

"There is a simple and pleasant way to study mathematics" is the philosophy on which the program of the Mathematics Institute at Duke University is based. Wouldn't summer sessions be fun if there weren't term papers to write and examinations to take? The Mathematics Institute at Duke is planned to combine stimulating work with invigorating play—all surrounded by the southern hospitality of North Carolina.

It has been said that he who graduated yesterday and stops studying today is uneducated tomorrow. How often have ten years of teaching experience become one year of experience repeated ten times! Professor W. W. Rankin of Duke University, who has been training teachers of mathematics for many years, realized for a long time the need for a means for teachers to keep up with what is going on in mathematics, to meet with other teachers and profit by their experiences, and to work with leaders in the field of the teaching of mathematics who are doing outstanding work. In 1941, Professor Rankin decided to do something about this problem, and organized the first Mathematics Institute at Duke. Since then it has grown steadily until in 1947 it attracted almost 200 people from 33 different states. Many of these people were on return engagements, having found the Institute so profitable in the past. The total mileage traveled to and from the Institute in 1947 was 240,000 miles!

The Institute is organized around a large Mathematics Laboratory begun by Professor Rankin many years ago. He states as the purposes of this Laboratory:

1. To assemble in one place a wide range of materials (machines, instruments, models, books—history, applications, philosophy, puzzles and recreations) showing the uses of mathematics and to make these materials easily available to teachers and students of mathematics.
2. To encourage students to acquire clearer concepts of the principles of mathematics and to learn some of the actual uses of mathematics in the work-a-day world.
3. To promote better teaching and a more intelligent study of mathematics by exhibiting machines, instruments, models, charts, side by side with formulas.
4. To give students an opportunity to make instruments, models, charts, etc. which demonstrate mathematical concepts and principles.
5. To offer a common meeting ground for students and teachers of mathematics with men of industry, science, and commerce.
6. To build a better understanding among educated people of the role mathematics plays in everyday affairs by showing the significance of mathematics and by telling the story of mathematics over the past 4000 years (mural paintings, books, etc.)

Besides giving an opportunity to browse in the Mathematics Laboratory, the Institute program is made up of lectures, study groups, and—last but not least—many social events. These social events last year included a tea and a watermelon

cutting at Professor Rankin's home, a reception at University House, a banquet at the Carolina Inn in Chapel Hill, two banquets in the Duke University Union, a carillon concert, and a conducted tour through the campus and university gardens.

The lectures were by outstanding people in many branches of mathematical work—high school teachers, college professors, engineers, and mathematicians from industry. Some of the industries represented were American Optical Co., Western Electric, Goodyear, Sperry Gyroscope, Hamilton Watch, Wright Automatic Machinery, International Business Machines, Clinton Laboratories, General Motors, Jam Handy Organization. Outstanding educational representatives from these companies discussed the uses of mathematics in their respective organizations, thus giving teachers a better idea of the importance of the subject they are teaching. A representative from the U. S. Bureau of Standards discussed recent trends in applied mathematics, a field of enormous possibilities in present-day life.

Study groups organized around the interests expressed by teachers coming to the Institute met every day and covered a variety of fields. The 1947 study groups were:

1. Aids in the Study of Geometry. Leader: Frances Burns, teacher of mathematics, Oneida High School, Oneida, New York.
2. Junior High School Mathematics. Leader: Mary C. Rogers, teacher of mathematics, Roosevelt Junior High School, Westfield, New Jersey.
3. Making and Using Films, Instruments, Models. Leader: Roger V. Zinn, Educational Consultant, Jam Handy Organization, Detroit, Michigan.
4. Enrichment of Mathematics Teaching. Leader: Veryl Schult, Director of Mathematics, Divs. 1–9, Public Schools of Washington, D. C.
5. Tests and Measurements. Leader: Elinor Douglas, Teacher of mathematics, Woodrow Wilson High School, Washington, D. C.
6. Field Work in Mathematics. Leader: Prof. H. C. Bird, Chairman, Civil Engineering, Duke University.
7. Applications of Mathematics to Science and Engineering; and Outlines of College Algebra, Plane Trigonometry, and Analytic Geometry. Leader: Prof. J. W. Cell, State College, Raleigh, North Carolina.

One wonders how one can absorb such a concentrated program in so little time. An "aid to memory" is the annual publication, *Highlights of the Institute*, which is a project carried out by those attending the Institute. It gives the summaries of lectures and study groups, a directory of those attending, valuable lists of materials with their sources and prices, and of course the art, wit, and humor expressive of the personality of the particular group. How enjoyable to sit back and enjoy programs without having to take notes, knowing that all will appear in the *Highlights!*

An interesting and worth while program is planned for the 1948 Institute at Duke from August 9 to August 20. It will include lecturers from various branches of industry, study groups on problems of interest selected by last year's group, and of course many "extra-curricular" events from excursions to watermelon-cutting. No college credit will be given, but a certificate of attendance will be provided. Many school superintendents, seeing the value of the programs in the past, have given professional credit for attendance. The cost to those attending this year will be a \$6 registration fee plus approximately \$3 a day for board and room on the beautiful campus.

We hope to see you down on the "you-all" side of the Mason-Dixon line. But if you're going, make your plans and register early, because the enrollment must be limited to 200 this year. Those planning to attend should register by June 1 with Prof. W. W. Rankin, Duke University, Durham, North Carolina.

# PROBLEM DEPARTMENT

CONDUCTED BY G. H. JAMISON
*State Teachers College, Kirksville, Mo.*

*This department aims to provide problems of varying degrees of difficulty which will interest anyone engaged in the study of mathematics.*

*All readers are invited to propose problems and to solve problems here proposed. Drawings to illustrate the problems should be well done in India ink. Problems and solutions will be credited to their authors. Each solution or proposed problem sent to the Editor* should have the author's name introducing the problem or solution *as on the following pages.*

*The editor of the department desires to serve its readers by making it interesting and helpful to them. Address suggestions and problems to G. H. Jamison, State Teachers College, Kirksville, Missouri.*

## SOLUTIONS AND PROBLEMS

**Note. Persons sending in solutions and submitting problems for solutions should observe the following instructions.**

**1. Drawings in India ink should be on a separate page from the solution.**

**2. Give the solution to the problem which you propose if you have one and also the source and any known references to it.**

**3. In general when several solutions are correct, the one submitted in the best form will be used.**

## LATE SOLUTIONS

**2059, 62, 3.** *P. S. Marlhakis, Salt Lake City.*

**2055, 9, 62, 63, 64.** *Hugo Brandt, Hyattsville, Md.*

**2059, 62, 3, 4.** *Oscar Marinoff, Denver.*

**2053, 60, 2, 4.** *C. W. Trigg, Los Angeles.*

**2063.** *W. R. Smith, Pass-A-Grille Beach, Fla*

**2059, 60, 2, 4.** *V. C. Bailey, Evansville, Ind.*

**2059, 62, 4.** *M. J. Chernofsky, Long Beach, N. Y.*

**2053, 9, 62.** *Helen M. Scott, Baltimore, Md.*

**2059, 62.** *Hazel S. Wilson, Annapolis, Md.*

**2059, 62, 3, 4.** *Wm. A. Richards, Cicero, Ill.*

**2059, 62, 3.** *Walter R. Warne, Alton, Ill.*

**2059, 60, 1, 2, 3.** *Robert H. Brooks, Chicago.*

**2059, 60, 2, 3, 4.** *W. J. Cherry, Berwyn, Ill.*

**2064, 2.** *A. W. Gordon, Chilton, Wis.*

**2062.** *Wayne Stepherdson, Huntington, Ind.*

**2059, 63.** *Robert E. Horton, Los Angeles.*

**2059, 60, 2.** *M. Kirk, Philadelphia.*

**2060, 4.** *W. R. Smith, Pass-A-Grille Beach, Fla.*

**2056, 62.** *V. H. Paquet, Colton, Oregon.*

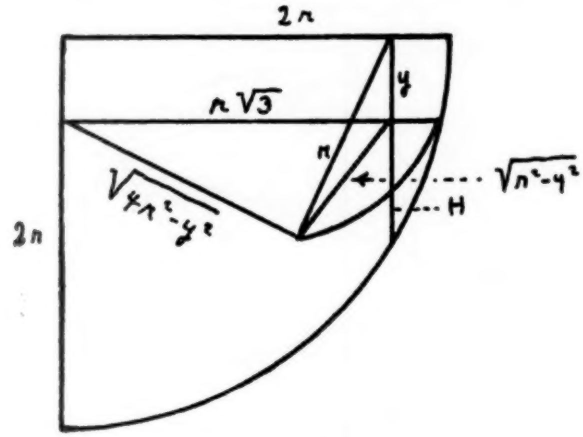
## A DELAYED SOLUTION

**2048.** *Proposed by Lyman J. Harris. Maryville, Tenn.*

A horizontal oil tank of diameter $D$ has dished ends, and is filled with oil to a height of $H$. The ends are dished out and are spherical segments of a sphere with a radius of $R$, where $R$ is equal to $D$. Find the volume of oil in the tank.

*Solution by W. J. Cherry, Berwyn, Ill.*

Let the radius of the cylinder $=r$. Then $D=R=2r$. Find the volume of oil in the dished ends by getting 4 times the volume generated by the segment of a circle shown in the figure.




$$V=4\left[\int\tfrac{1}{2}(4r^2-y^2)\arcsin\frac{\sqrt{r^2-y^2}}{\sqrt{4r^2-y^2}}\,dy-\int\frac{r\sqrt{3}\sqrt{r^2-y^2}}{2}\,dy\right]_{r-H}^{r}$$

$$=4\left[2r^2\int\arcsin\frac{\sqrt{r^2-y^2}}{\sqrt{4r^2-y^2}}\,dy-\tfrac{1}{2}\int y^2\arcsin\frac{\sqrt{r^2-y^2}}{\sqrt{4r^2-y^2}}\,dy-\frac{r\sqrt{3}}{2}\int\sqrt{r^2-y^2}\,dy\right]_{r-H}^{r}$$

$$=4\left[\left\{2r^2y\arcsin\frac{\sqrt{r^2-y^2}}{\sqrt{4r^2-y^2}}+4r^3\arctan\frac{y\sqrt{3}}{2\sqrt{r^2-y^2}}-2r^3\sqrt{3}\arcsin\frac{y}{r}\right\}\right.$$

$$-\tfrac{1}{2}\left\{\frac{y^3}{3}\arcsin\frac{\sqrt{r^2-y^2}}{\sqrt{4r^2-y^2}}+\frac{r\sqrt{3}}{3}\left(\frac{-9r^2\arcsin\frac{y}{r}}{2}+\frac{y\sqrt{r^2-y^2}}{2}\right.\right.$$

$$\left.\left.\left.+\frac{8r^2\sqrt{3}}{2}\arctan\frac{y\sqrt{3}}{2\sqrt{r^2-y^2}}\right)\right\}-\left\{\frac{ry\sqrt{3}}{4}\sqrt{r^2-y^2}+\frac{r^3\sqrt{3}}{4}\arcsin\frac{y}{r}\right\}\right]_{r-H}^{r}$$

$$=4\left[\left(2r^2y-\frac{y^3}{6}\right)\arcsin\frac{\sqrt{r^2-y^2}}{\sqrt{4r^2-y^2}}+\frac{8}{3}r^3\arctan\frac{y\sqrt{3}}{2\sqrt{r^2-y^2}}-\frac{3}{2}r^3\sqrt{3}\arcsin\frac{y}{r}\right.$$

$$\left.-\frac{r\sqrt{3}}{3}\,y\sqrt{r^2-y^2}\right]_{r-H}^{r}.$$

As a partial check of the above equation we may use the limits $r$ and 0, thus getting the volume of a spherical segment of one base. Using these limits we find the volume $=\pi r^3(\frac{16}{3}-3\sqrt{3})$, which is also what we get if we use the formula given in solid geometry. To get the volume of oil in the cylinder, multiply the length $(L)$

by

$$2\int_{r-H}^{r} \sqrt{r^2-y^2}\, edy$$

$$V=L\left[y\sqrt{r^2-y^2}+r^2 \text{ arc sin } \frac{y}{r}\right]_{r-H}^{r}$$

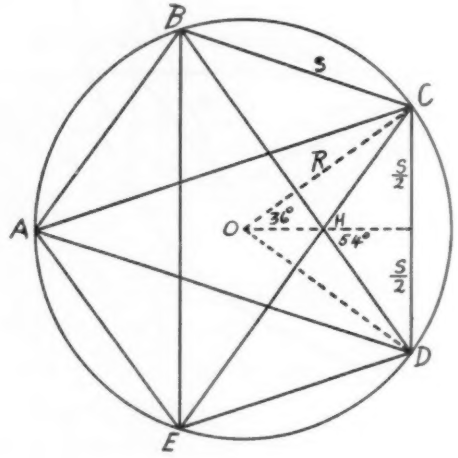
Francis L. Miksa also offered a solution.

**2065**. *Proposed by Hugo Brandt, Chicago, Illinois.*

If the diagonals of a regular pentagon (inscribed in a circle) are drawn, they outline a star. Compare the area of the star with that of the circle.

*Solution by V. C. Bailey, Evansville, Indiana*

Let $s$ be a side of the regular pentagon and $R$ a radius of the circle.




$$s=2R \sin 36°$$

$$\text{Area of } \Delta CHD=R^2 \sin^2 36° \tan 36°$$

$$\text{Area of pentagon } ABCDE=\frac{5}{2} R^2 \sin 72°=5R^2 \sin 36° \cos 36°$$

The area of the star equals the area of the pentagon less 5 times the area of triangle $CHD$.

$$\frac{\text{Area of Star}}{\text{Area of Circle}}=\frac{5R^2 \sin 36° \cos 36°-5R^2 \sin^2 36° \tan 36°}{\pi R^2}$$

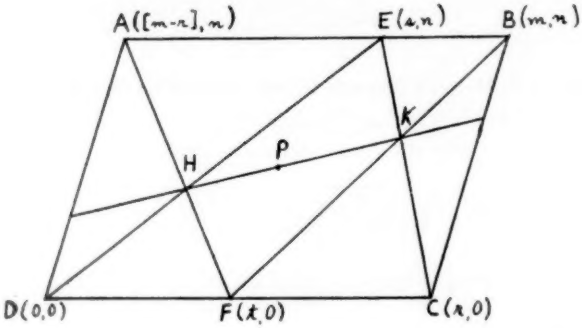
$$\frac{\text{Star}}{\text{Circle}}\ \frac{5(3-\sqrt{5})\sqrt{10-2\sqrt{5}}}{8\pi}=\frac{35.5}{100}$$

Obviously, the answer may be given in a number of different forms.

Solutions were also offered by Francis L. Miksa, Aurora, Ill.; Margaret Joseph, Milwaukee, Wis.; W. R. Smith, Pass-A-Grille Beach, Fla.; Walter H. Carnahan, Boston; Hugo Brandt, University of Maryland; Donald Block, New York; Felix John, Ammendale, Md.

**2066**. *Proposed by D. McLead, Winnipeg, Manitoba*

In parallelogram, $ABCD$, $E$ is any point in $AB$, $F$ is any point in $DC$. $AF$ meets $DE$ in $H$, and $BF$ meets $EC$ in $K$. Prove that the line $HK$ bisects $ABCD$.




*Solution by Aaron Buchman, Buffalo, N. Y.*

Choose the following coordinates for the points:

$$A([m-r],\ n);\ B(m,\ n);\ C(r,\ 0);\ D(0,\ 0);\ E(s,\ n);\ F(t,\ 0)$$

The equation of $DE$ is $x/y=s/n$.
The equation of $AF$ is $(x-t)/y=(m-r-t)/n$.
Then the coordinates of their intersection, $H$, are

$$\left(\frac{st}{r-m+s+t},\ \frac{nt}{r-m+s+t}\right).$$

The equation of $CE$ is $(x-r)/y=(s-r)/n$.
The equation of $BF$ is $(x-t)/y=(m-t)/n$.
Then the coordinates of their intersection, $K$, are

$$\left(\frac{mr-st}{r+m-s-t},\ \frac{nr-nt}{r+m-s-t}\right).$$

Let $P$ be the center of the parallelogram $ABCD$.
Then the coordinates of $P$ are $(m/2,\ n/2)$.
The slope of line $HP$ is

$$\frac{\dfrac{nt}{r-m+s+t}-\dfrac{n}{2}}{\dfrac{st}{r-m+s+t}-\dfrac{m}{2}}=\frac{nt-nr+mn-ns}{2st-mr+m^2-ms-mt}.$$

The slope of line $PK$ is

$$\frac{\dfrac{n}{2}-\dfrac{nr-nt}{r+m-s-t}}{\dfrac{m}{2}-\dfrac{mr-st}{r+m-s-t}}=\frac{nt-nr+mn-ns}{2st-mr+m^2-ms-mt}.$$

Therefore $HPK$ is a straight line passing through the *center* of parallelogram $ABCD$. From this, it is easily proved that $HPK$ bisects $ABCD$.

**2067.** *Proposed by Gay Eggers, St. Johns, Newfoundland.*

Find the area of the triangle whose sides are

$$\frac{x}{y}+\frac{y}{z},\quad \frac{y}{z}+\frac{z}{x},\quad \frac{z}{x}+\frac{x}{y}.$$

*Solution by Max Beberman, Nome, Alaska*

Calling the sides $a$, $b$, $c$, and

$$s=\frac{a+b+c}{2}=\frac{x}{y}+\frac{y}{z}+\frac{z}{x}$$

then substituting in Heron's formula for the area of a triangle

$$A=\sqrt{s(s-a)(s-b)(s-c)}$$

we have

$$A=\sqrt{\left(\frac{x}{y}+\frac{y}{z}+\frac{z}{x}\right)\left(\frac{z}{x}\right)\left(\frac{x}{y}\right)\left(\frac{y}{z}\right)}$$

$$A=\sqrt{\frac{x}{y}+\frac{y}{z}+\frac{z}{x}}=\sqrt{s}$$

Francis L. Miksa, Aurora, makes this comment: It is interesting to note, that it is possible to so choose $x$, $y$ and $z$ that the quantity under the radical will become an integer. See *American Mathematical Monthly*, 1946, pp. 222–224 for a solution of this problem. Here are a few examples:

For $(x, y, z)=(1, 1, 1)$; $(1, 2, 4)$; $(3, 350, 196)$ we get

$$A=\sqrt{3}, \quad \sqrt{6}, \quad \sqrt{41}.$$

Other solutions were offered by O. A. George, Mason City, Ia.; C. W. Trigg, Los Angeles; Felix John, Ammendale, Md.; Helen M. Scott, Baltimore, Md.; W. R. Smith, Pass-A-Grille Beach, Fla.; V. C. Bailey, Evansville, Ind.; Daniel Block, New York.

**2068**. *Proposed by V. C. Bailey, Evansville, Ind.*

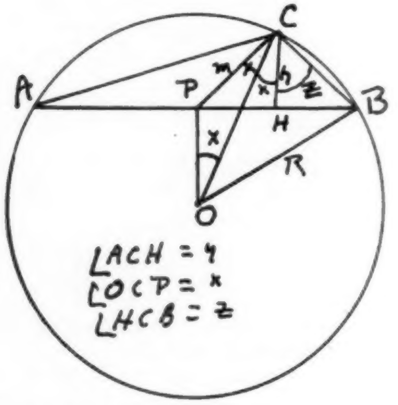
In triangle $ABC$ the circumradius bisects the angle between $h_c$ and $m_c$. Find the maximum and minimum values of angle $C$.

*Solution by Francis L. Miksa, Aurora, Ill.*

Referring to the figure, with $m_c$ and $h_c$ given, and angle $PCH$ bisected, the entire triangle $ABC$ is determined. For then angle $POC=x$ and $PO=m_c$. $OC$ will then equal $R$, the radius of the circumcircle. From figure (dropping the subscript $c$)

$$PH=m^2-h^2 \tag{1}$$

$$\cos 2x=h/m. \tag{2}$$




Using cosine law and triangle $POC$

$$\begin{aligned} R^2&=m^2+m^2-2m^2\cos(180°-2x)=2m^2(1+\cos 2x)\\ R^2&=2m(m+h). \end{aligned} \tag{3}$$

Using triangle $BHC$ and $AHC$

$$\tan z = HB/h \qquad \tan y = HA/h; \qquad \underline{/(z+y)} = \underline{/C}.$$

Using triangles $AOP$ and $BPO$ and eq. (3)

$$HB = BP - PH = \sqrt{R^2-m^2} - \sqrt{m^2-h^2} = \sqrt{m^2+2mh} - \sqrt{m^2-h^2} \tag{4}$$

$$HA = AP + PH = \sqrt{R^2-m^2} + \sqrt{m^2-h^2} = \sqrt{m^2+2mh} + \sqrt{m^2-h^2} \tag{5}$$

So that

$$\tan z = \frac{\sqrt{m^2+2mh} - \sqrt{m^2-h^2}}{h} \tag{6}$$

$$\tan y = \frac{\sqrt{m^2+2mh} + \sqrt{m^2-h^2}}{H}. \tag{7}$$

Now

$$\tan C = \tan(z+y) = \frac{\tan z + \tan y}{1 - \tan z \tan y}. \tag{8}$$

Using values from (6) and (7) in (8) we get

$$\tan C = \frac{2/h\sqrt{m^2+2mh}}{1-(1/h^2)(m^2+2mh-m^2+h^2)}.$$

This reduces to

$$\operatorname{Tan} C = -\sqrt{1+2h/m} \tag{9}$$

Now it is evident that there will be no loss of generality if we keep $h$ fixed, say $h=1$ and vary $m$. Evidently $m$ can vary from $m=1$ (a case where $m_c = h_c$) and $m = \infty$. Using $h=1$

$$\tan C = -\sqrt{1+2/m}. \tag{10}$$

For $m=1$

$$\tan C = -\frac{-\sqrt{3}}{1}$$

$$C = 120°.$$

This is the minimum value of $C$.

For $m=\infty$

$$\operatorname{Tan} C = -1$$

$$C = 135°.$$

This is the maximum value of $C$.

Those then are the minimum and maximum values of angle $C$ when the circumradius bisects the angle between $m_c$ and $h_c$.

A solution was also offered by the proposer.

**2069.** *Proposed by Norman Anning, University of Michigan*

Solve the system for $x$, $y$, $z$, $w$.

$$1+w = xy \tag{1}$$

$$2+z = x+y \tag{2}$$

$$p^2+w = xz \tag{3}$$

$$q^2+w = yz \tag{4}$$

*Solution by C. W. Trigg, Los Angeles City College*

Upon substituting the value of $w$ from (1) and the value of $z$ from (2) in (3)

$x^2-2x+1=p^2$, so

$$x=1+p \qquad \text{or} \qquad x=1-p.$$

From (1):

$$w=y+py-1 \qquad\qquad w=y-py-1.$$

From (2):

$$z=y+p-1 \qquad\qquad z=y-p-1.$$

Substituting these values of $w$ and $z$ in (4):

$$y^2-2y+1=q^2 \qquad\qquad y^2-2y+1=q^2$$

$$y=1\pm q \qquad\qquad y=1\pm q.$$

Then

$$z=p\pm q \qquad\qquad z=-p\pm q$$

$$w=\pm q(p+1)+p \qquad\qquad w=\pm q(1-p)-p.$$

Solutions were also offered by Aaron Buchman, Buffalo, N. Y.; Felix John, Ammendale, Md.; Helen M. Scott, Baltimore; Francis Miksa, Aurora, Ill.; O. A. George, Mason City, Ia.; Max Beberman, Nome, Alaska; Daniel Block, N.Y.; and the proposer.

**2070**. *Proposed by Belle Conley, Newark, N. J.*

Prove that $(x+y+z)^n-x^n-y^n-z^n$ is divisible by $(y+z)(z+x)(x+y)$ with $n$ odd.

*Solution by Felix John, Ammendale, Md.*

Let $E=(x+y+z)^n-x^n-y^n-z^n$. Then if $y=-z$, or $z=-x$, or $x=-y$, the value of $E$ becomes 0 if $n$ is odd. Therefore, $(y+z)$, $(z+x)$ and $(x+y)$ are factors of $E$.

The other factors are some number $k$ and an expression of degree $(n-3)$, symmetrical in $x$, $y$, and $z$.

Solutions were also offered by Francis L. Miksa, Aurora, Ill.; V. C. Bailey, Evansville, Ind.; C. W. Trigg, Los Angeles; O. A. George, Mason City, Ia.; Max Beberman, Nome, Alaska; Daniel Block, New York.

## HIGH SCHOOL HONOR ROLL

**The editor will be very happy to make special mention of high school classes, clubs, or individual students who offer solutions to problems submitted in this department. Teachers are urged to report to the Editor such solutions.**

**For this issue the Honor Roll appears below:**

**2062.** *Clifford Spector, New York; Tom Hart and Dick Rody, Chilton, Wis.*

**2059, 62.** *Dwight Conway, Long Beach, Calif.*

**2053.** *James J. Plunkett, Jr., Morristown, N. J.*

**2057.** *V. Anselm Murray, Morristown, N. J.*

**2059, 60, 1, 2, 3, 4.** *H. F. Trotter, Toronto*

**2059, 62.** *C. J. McCombe, Toronto*

**2062.** *D. H. McKenzie, Toronto.*

**2065, 7.** *Robert Gunning, Longmont, Colo.*

## PROBLEMS FOR SOLUTION

**2083.** *Proposed by Felix John, Ammendale, Md.*

Show that the roots of the equation

$$x^4-px^3+qx^2-rx+\frac{r^2}{p^2}=0$$

form a proportion. (From Hall and Knight's *Higher Algebra*.)

**2084.** *Proposed by Jack Couch, Hanceville, Ala.*

A yard is in the shape of a circle with diameter 100 yd. Two perpendicular diameters $NS$ and $WE$ are drawn. A light is located at $S$ (south). A boy walks from $W$ (west) toward $E$ at a speed of 5 mph. At what rate is his shadow moving around the edge of the yard? At the point $NW$ (mid point of arc $WN$) what rate is the shadow moving?

**2085.** *Proposed by Felix John, Ammendale, Md.*

If the angles of a triangle are in the ratio of 3:4:5, and if the perimeter is $p$, find the area in terms of $p$.

**2086.** *Proposed by Charles Reade, Romulus, N. Y.*

Sum the series

$$(1\cdot 2\cdot 4)+(2\cdot 3\cdot 5)+(3\cdot 4\cdot 6)+\cdots \text{ to } n \text{ terms.}$$

**2087.** *Proposed by Norman Anning, University of Michigan*

Solve the equation: Tan $D=-\text{Cot } 2D$.

**2088.** *Proposed by Addison Taylor, Northfield, Minn.*

Solve the system:

$$(x^2+y^2)xy=13090$$
$$x+y=18$$

---

## BOOKS AND PAMPHLETS RECEIVED

ELEMENTS OF RADIO, by Abraham Marcus and William Marcus. Prepared under the Editorship of Ralph E. Horton. Second Edition. Cloth. Pages xv+751. 13.5×20 cm. 1948. Prentice-Hall, Inc., 70 Fifth Avenue, New York 11 N. Y. Price $4.25.

METHODS OF ALGEBRAIC GEOMETRY. by W. V. D. Hodge, M.A., F.R.S., *Lowndean Professor of Astronomy and Geometry, and Fellow of Pembroke College, Cambridge;* and D. Pedoe, B.A., Ph.D., *Sometime Charles Kingsley Bye-Fellow of Magdalene College, Cambridge.* Cloth. Pages viii+440. 13.5×21.5 cm. 1947. Cambridge University Press, The Macmillan Company, 60 Fifth Avenue, New York 11, N. Y. Price $6.50.

WHOM THE GODS LOVE. THE STORY OF EVARISTE GALOIS, by Leopold Infeld Cloth. Pages ix+323. 13.5×20.5 cm. 1948. Whittlesey House, McGraw-Hill Book Company, Inc., New York 18, N. Y. Price $3.50.

APPLIED ARCHITECTURAL ACOUSTICS, by Michael Rettinger, B.A., M.A., *Engineering Department RCA Victor Division, Radio Corporation of America, Hollywood, California.* Cloth. Pages xi+189. 13.5×21.5 cm. 1947. Chemical Publishing Company, Inc., 26 Court Street, Brooklyn 2, N. Y. Price $5.50.

NOMOGRAPHY, by A. S. Levens, M.S., C.E., *Associate Professor of Mechanical Engineering, University of California, Berkeley, Calif.* Cloth. Pages viii+176. 14.5×23 cm. 1948. John Wiley and Sons, Inc., 440 Fourth Avenue. New York 16, N. Y. Price $3.00.

HEAT, by Archie G. Worthing, *Professor of Physics, University of Pittsburgh*, and David Halliday, *Assistant Professor of Physics, University of Pittsburgh.* Cloth. Pages xii+522. 14.5×23 cm. 1948. John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. Price $6.00.

OUR NEIGHBORS SERIES: GRADE III, OUR NEIGHBORS AT HOME, GRADE IV, NEIGHBORS AROUND THE WORLD, by J. Russell Smith, Ph.D., Sc.D., *formerly Professor of Economic Geography, Columbia University*, and Frank E. Sorenson Ph.D., *Associate Professor of Education, University of Nebraska.* Cloth. 19×25 cm. 1947. Grade III 256 pages, Price $1.92. Grade IV, 320 pages. The John C. Winston Company, Philadelphia 7, Pa. Price $2.16.

COLLEGE ALGEBRA, by H. A. Simmons, *Associate Professor of Mathematics, Northwestern University.* Cloth. Pages viii+619. 14×21.5 cm. 1948. The Macmillan Company, 60 Fifth Avenue, New York, N. Y. Price $4.00.

THE ATOM, by Sir George Thomson, *Professor of Physics at Imperial College, Cambridge, England.* Third Edition. Cloth. Pages vii+196. 10×16½ cm. 1947. Oxford University Press, 114 Fifth Avenue, New York 11, N. Y. Price $2.00.

BIOLOGY LABORATORY NOTEBOOK, by Sol M. Rudin, MS. *Instructor in Science, New York City Schools*, and Peter Greenleaf, MA., *Chairman, Science Department, Eron Preparatory School, New York City.* Paper. 144 pages. 20.5×27 cm. 1946. Globe Book Company, Inc., 175 Fifth Avenue, New York 10, N. Y. Price in quantities of 10 or more copies 90 cents.

MECHANICAL DRAFTING ESSENTIALS. TECHNICAL SKETCHING, MECHANICAL DRAFTING, BLUE PRINT READING, by Walter E. Farnham, *Tufts College Engineering School*, and Francis T. McCabe, *Rindge Technical School.* Paper. 196 pages. 21×28 cm. 1948. Prentice-Hall, Inc., 70 Fifth Avenue, New York 11, N. Y. Price $2.75.

LET'S FIGURE FOR IMPROVED LIVING. MATHEMATICS PRINCIPLES APPLIED TO THE IMPROVEMENT OF HOME LIVING WITH PROBLEMS FOR GRADE SEVEN, by Anna K. Keene. Paper. 63 pages. 15×23 cm. 1947. Project in Applied Economics, College of Education, University of Florida, Gainesville, Fla. Price 35 cents (A 20% quantity discount is allowed when 25 or more copies are ordered at one time).

SPINNERET CHILDREN, by Alma Watson. Paper. 51 pages. 15×22.5 cm. 1947. Project in Applied Economics, College of Education, University of Florida, Gainesville, Fla. Price 35 cents (A 20% quantity discount is allowed when 25 or more copies are ordered at one time).

GUIDANCE PAMPHLET IN MATHEMATICS FOR HIGH SCHOOL STUDENTS. Final Report of the Commission on Post-War Plans of the National Council of Teachers of Mathematics. Paper. 25 pages. 17×26 cm. The Mathematics Teacher, 525 W. 120th Street, New York 27, N. Y.

## BOOK REVIEWS

SUNSPOTS IN ACTION, by Harlan True Stetson, Ph.D., *Research Associate, Massachusetts Institute of Technology, Director, Cosmic Terrestrial Research Laboratory, Needham, Massachusetts.* Cloth. Pages xiv+252. 14.5×21 cm. 1947. The Ronald Press Company, 15 E. 26th Street, New York 10, N. Y. Price $3.50.

Now at the height of greatest sunspot activity for many years is an excellent time to read the observations of a master student in this field. If you have thought of sunspots as a subject of interest to the astronomer only this book will

be a revelation to you. Here we are told, in language that everyone with an ordinary education can read, how sunspots have at times completely garbled all radio communication, how they have affected tree growth, their influence on rainfall and other weather conditions, the probability of their effect on the trapping of foxes and rabbits, and the possibility of their action on health, markets, and financial depressions. The author points out that during World War II the exact time of airplane action was often determined by the probability of good or poor radio communication which was often seriously affected by the action of the sun on reflecting layers of the ionosphere. He discusses the importance of radio communication and weather reports on travel, commerce, farming and other industries, and shows the importance of the Federal Communications Commission in many phases of daily life. The merits of frequency modulation over amplitude modulation are well brought out. In the last chapter Dr. Stetson has a good thought for our training institutions: "We need to train scientists as well as technicians—scientists who, while specialists in their own field, continually cultivate that attitude of thinking and that habit of open-mindedness which so recognizes the interrelations of diversified fields as to lead the way to the solution of problems that no single territory of knowledge alone can ever solve."

On page 19 the text errs in attributing four planetary electrons to the structure of helium but this makes little difference in the thought involved. A second error occurs in the table on page 139 where the period of revolution of Neptune, 164.783 years, is substituted for that of Uranus, 84.02 years.

G. W. W.

THEORY OF FUNCTIONS, by J. F. Ritt, *Davies Professor of Mathematics, Columbia University*, revised Edition. Paper, plastic binding. Pages x+181. 21×23 cm. 1947. King's Crown Press, Division of Columbia University, New York, N. Y. Price $3.00.

This text covers the basic material of a one year course in function theory, a little less than half of the material is devoted to real variable theory, the balance to complex variable theory.

The material seems exceptionally readable from the students' standpoint. The treatment in many cases seems a less radical change from earlier courses than would be the case with some texts. There are no problems or exercises to give the reader opportunity to extend the theory. An interesting item is the letters Q. E. D at the end of a proof of a theorem, a practice bringing back memories to the older generation, but which distinctly puzzled a young graduate student.

The amount of material covered is perhaps more, covered in somewhat less detail, than in some other texts in function theory. A student who has covered this material in class should be able to carry on independent reading in more advanced texts. The preference of the individual teacher governs text selection; some teachers and students may not like the binding and typography; nevertheless the instructor seeking a suitable text for a first course in function theory cannot afford to overlook careful consideration of this book—in many ways it is one of the best available.

CECIL B. READ

THE THEORY OF MATHEMATICAL MACHINES, by Francis J. Murray, *Associate Professor of Mathematics, Columbia University*. Paper, plastic binding. Pages viii+118. 21.5×28 cm. 1947. King's Crown Press, Division of Columbia University, New York, N. Y. Price $3.00.

This book attempts to present the basic principles and theory of mathematical machines; material which up to this time has been available, if at all, only in widely scattered references.

The scope of material covered is indicated by the contents: Digital Machines; Continuous Operators; Solution of Problems; Mathematical Instruments. To read the text as a whole, one needs a knowledge of mathematics through at least differential equations. However, certain portions could be read by a good high

school senior. The material on digital machines (covering counters, adders, multipliers, and punched card machines) is of this nature and furnishes a good answer to the question "How does an adding machine work?" On the other hand, material on planimeters, the integraph, integrators and differentiators is not within the grasp of the ordinary secondary school student, and much of it will be too mature for the junior college student.

The small type is somewhat tiring to read. A minor misprint was noted on page 99. The pronunciation indicated for the word *abacus* is not in agreement with one standard dictionary.

CECIL B. READ

A HANDBOOK ON CURVES AND THEIR PROPERTIES, by Robert C. Yates, *United States Military Academy*. Cloth. Pages x+245. 13.5×21.5 cm. 1947. J. E. Edwards, Ann Arbor, Mich. Price $3.25.

An earlier edition, entitled *Curves*, prepared for use in the department of mathematics at the United States Military Academy, was reviewed in the March 1947 SCHOOL SCIENCE AND MATHEMATICS. Reference to that review may bring out information which it seems unnecessary to repeat here.

The book provides reference to many properties of a large number of plane curves (and a few surfaces). In addition to material on each particular curve, sections are devoted to explanation of certain items mentioned in the discussion of many curves; i.e., envelopes, evolutes, intrinsic equations, roulettes, curve sketching, etc.

The changes from the earlier edition are largely minor additions or improvements; such are found in the treatment of pursuit curves, conchords, caustics, envelopes, the strophoid, sketching, tractrix, witch, mercators map. The section entitled *light* has been omitted; figure 109 is new.

The material is lithoprinted, and has been entirely retyped—the resulting typography is an improvement and easier to read. Usage is not always consistent i.e. arc cos x and arc sin x. The paper in this edition is thin and somewhat objectionable in that curves on the reverse side of the sheet tend to show through the paper.

This book is almost invaluable as a reference work. The reviewer's copy of the first edition has been constantly in use by instructors in analytic geometry and calculus. No school library can afford to be without a copy; the same is essentially true for the teacher.

CECIL B. READ

PLANTS. A GUIDE TO HOBBIES, by Herbert S. Zim. Cloth. 398 pages. 13×20.5 cm. 1947. Harcourt, Brace and Company, 383 Madison Avenue, New York 17, N. Y. Price $3.50.

Dr. Zim's book has much to offer and can be of worthwhile use especially on science reference shelves of high schools and junior colleges. Although the title of the book may not attract the average reader, a few pages of reading will soon win him. The author has given a very interesting treatment to a subject that has inherent difficulties. Botany does not have the dramatic and dynamic appeal for the layman, which Zoology by nature can claim.

Probably no chapter in a science book can claim any less general interest than one on identification and classification. The author's simple and logical development of these "Twin Problems" here will hold the reader's attention better than most attempts to explain their value and need.

The more conspicuous and typical representatives of the great plant groups are introduced to the reader with tid-bits of information throughout 7 of the 22 chapters in this book. The illustrations, black and white drawings, are commendable especially for their simplicity and faithfulness to the plants sketched. These drawings may be even more enjoyed by those recognizing the plants.

Other chapters that will claim special interest are: "Plants of the Past," "Plant Experiments," "Plant Propogation," and "Chemicals and Plant Experiments."

Dr. Zim's two chapters on "Plant Life and Regions" and "Plant Localities Worth Visiting" make his book a useful aid for travelers having an interest in plants in that it provides them with brief, but helpful, lists and descriptions.

This book is sufficient stimulus to activate those persons wishing to know something about plants. It will also offer enjoyment for those who are more familiar with them.

JOSEPH P. MCMENAMIN

OLD WORLD LANDS, by Harlan H. Barrows, *Department of Geography, University of Chicago,* Edith Putnam Parker, *Department of Geography, University of Chicago,* and Clarence Woodrow Sorensen, *Special Lecturer in Geography, Community Program Service, University of Minnesota.* Cloth. Pages vi+346. 21.5×27.5 cm., 264 Figures—maps, sketches and photographs. Drawings by Milo Winter. 1947. Silver Burdett Company, New York, Chicago and San Francisco. List Price $2.88.

Old World Lands is a Sixth Grade text and the third in the *Man In His World* series of essential elementary geographies. It is an interesting presentation of the geography of four continents. It is modern. It is written in terms of people and the lands they occupy. It presents many critical world problems in their geographic setting, and provides opportunity for a better understanding and appreciation of these problems. It is a distinct departure from former textbooks as it introduces considerable historical background material.

The organization of the text departs radically from the usually accepted pattern. It enables the child to view the lands of the old world in relation to each other. It makes them living, functioning parts of a modern world.

The text is attractively illustrated with about one hundred sketches and over one hundred excellent photographs. Most of the sketches are in color. All illustrations are without margins. Some forty maps are distributed through the text. The physical-political maps occupy full pages, and have colors that are clear and distinct. There is a liberal supply of rainfall and population maps, as well as several special purpose maps.

Each section of the text has its "Helps in Learning." These consist of several well directed questions which check the child's geographic understandings. Statistical tables and an Index, with Key to Pronunciation, add much to the serviceability of the book.

VILLA B. SMITH

MY BIG WORLD, BASED ON OUR BIG WORLD, by Harlan H. Barrows, Edith Putnam Parker, and Clarence Woodrow Sorensen. Paper. Pages ii+127. 21×27.5 cm. 90 Figures—maps, sketches, spaces for pupil-made sketches. 1947. Silver Burdett Company, New York, Chicago and San Francisco. List Price $0.60.

This workbook for Fourth Grade pupils accompanies the text *Our Big World* It provides opportunity for a variety of pupil activities, all of which contribute to the development of an initial world understanding. It furnishes pictures, maps and reading material, and guidance in their use. It is closely integrated with the text, but provides new situations for the use of text materials.

The Fourth Grade teacher, long confronted with the problem of securing materials for pupil use, will find *My Big World* a valuable aid. The final section, "A Letter To Each Teacher-Editor," is for her help and guidance.

An alert Fourth Grade child will find the workbook a real challenge. He will be an active learner, engaged in purposeful and worthwhile activities.

VILLA B. SMITH

TEACHERS' GUIDE AND TEXTBOOK TO ACCOMPANY OUR BIG WORLD, by Beatrice Collins. Paper. Pages 128. 21×26.5 cm. 1947. Silver Burdett Company, New York, Chicago and San Francisco. List Price $1.00.

This Teachers' Guide and Textbook accompanies *Our Big World* by Barrows,

Parker and Sorensen. It is an invaluable handbook for the teacher. It presents a new geography program for the elementary school, outlining its point of view and calling attention to the geographic understandings and to the specific skills it is to develop. Reading skills, picture-reading skills, globe-reading skills, map-reading skills, skills in direct observation, skills in geographic thinking, skills in speaking, writing and spelling are discussed. The map- and globe-reading program is presented in great detail.

Each unit of *Our Big World* is carefully outlined for teacher use. The time required for each unit is indicated. The specific understandings and the general understandings, and skills-development are presented for each. Helpful suggestions for teaching are also given. A supplementary reading list furnishes additional materials for those who wish them.

The Textbook presents a most excellent and comprehensive testing program, and indicates the points at which tests are to be given. The tests are arranged in groups, several different types making up each group. The Textbook suggests ways for evaluating test results and analyzing pupil errors, thus making tests a valuable teaching tool. These tests may be reproduced in any way the teacher sees fit.

VILLA B. SMITH

ROMPING THROUGH MATHEMATICS, by Raymond W. Anderson; illustrated by Harry Zarchy. Cloth. Pages 152. 16×21 cm. 1947. Alfred A. Knopf, Inc., New York, N. Y. Price $2.50.

Another attempt to provide a simple view of elementary mathematics through differential and integral calculus. A once over lightly treatment is given to selected topics from the usual course divisions.

The presentation is informal and stresses the development in a pseudo-historical manner. In several instances the accuracy of statements may be questioned, such as attributing the beginning of use of the decimal point to the time of the French Revolution, but it seems that liberties of this nature may have been taken in the spirit of poetic license in order to enhance the interest and readability of the narrative. No attempt is made to consider any sort of detailed mathematical procedure. Rather than this, the emphasis is upon furnishing a very general view in order to arouse the interest of the reader.

This volume should prove to be of interest to the layman from a cultural viewpoint. The student may gain from the general picture it presents in contrast to the highly detailed work to which he has been exposed. The teacher should find the informal manner in which the topics are developed refreshingly new. This book should be a must for the high school mathematics library.

W. K. MCNABB
Rockaway Junior College
Dallas 6, Texas

ALGEBRA FOR COLLEGE STUDENTS, by Jack R. Britton, Ph.D., *Associate Professor of Engineering Mathematics;* and L. Clifton Snively, M. S. (E.E.), *Assistant Professor of Engineering Mathematics, University of Colorado.* Cloth. Pages xi+529. 14×21.5 cm. 1947. Rinehart and Company, Inc., 232 Madison Avenue, New York 16, N. Y. Price $3.00.

"The first twelve chapters will, we believe, furnish an adequate course in intermediate algebra; the last eleven chapters of the book develops the topics customarily covered in a course in college algebra."

The above quotation is included in the preface of the book. Examination of the first twelve chapters reveals that the explanations, the illustrative examples and the problems of these chapters are so stated as to meet the needs of either of the groups that commonly enroll in college algebra. For those who enroll without a satisfactory background of high school mathematics it would seem advisable to study these chapters in detail; while for the student with adequate background, the drill and review that are needed before proceeding further in algebra may be

secured in this section. The method of presentation in these twelve chapters is good, the illustrations are adequate, and the number of exercises is great enough to provide for selection in taking care of individual differences either in ability or in preparation.

The last eleven chapters include: approximate numbers, logarithms, the binomial theorem and mathematical induction, progressions, complex numbers, inequalities, advanced topics in quadratic equations, theory of equations, systems involving quadratic equations, determinants, and permutations, combinations and probability. The method of approach is similar to that in the first twelve chapters, although the explanations are made for a developing college student. Poorer students will have some difficulty with this section of the book but the average or superior student should enjoy it.

The various topics of the book are presented so that they should be interesting to both student and instructor. The 142 sets of exercises provide a sufficient number of exercises so that provision can easily be made for individual differences. There are three tables in the appendix: Powers, Roots, and Reciprocals: Five place common logarithms: Natural logarithms. Answers to odd-numbered problems are also given in the appendix. *Algebra for College Students* is well presented, attractively bound, and those who are looking for a new college algebra should include it in their list of books for consideration.

ALBERT R. MAHIN
Broad Ripple High School
Indianapolis, Indiana

SCHOOL HEALTH PROBLEMS, by Laurence B. Chenoweth, A. B., M. D., *Professor of Hygiene, University of Cincinnati*, and Theodore K. Selkirk, A.B., M.D., *Assistant Professor of Clinical Pediatrics, College of Medicine, University of Cincinnati.* Third Edition. Cloth. Pages xii + 419. 15×21 cm. 1947. F. S. Crofts & Co., New York. Price $3.00.

The authors say that the purpose of this book is "to acquaint students of education, teachers in service, and others interested, with the broad general nature of health problems in schools. Its goal is to develop health consciousness among teachers and pupils to as great an extent as possible." The choice of materials in this book seems to verify the above purpose.

The book contains excellent illustrations and charts for reference. However, a few of these might be more effective if they were larger in size. There is a very logical and clear organization of the nineteen chapters which makes future reference to various sections quite easy.

Some words that may be uncommon to the average (present or future) educator are well defined in a good glossary near the end of the book. An adequate index is found at the close of the book, also.

A list of well-chosen reference reading is found at the close of each Unit. Because of the vast amount of health literature now available, the authors have carefully picked and listed only the most pertinent ones. A section on "Outline on School Health Administration" by Richard Arthur Bolt, M.D., Dr. P. H., has been included in the book. This is well done and valuable reference for actual administration details related to the school health program.

H. KEITH CADY
Oak Park, Illinois

## NEW PLASTICS LABORATORY

Opening of a new plastics laboratory, first of its kind in the camera industry, was announced by Eastman Kodak Company.

The laboratory, located in the company's Camera Works, is equipped for a broad range of experimental studies.

Kodak is using the laboratory to intensify its development of plastic parts for cameras, projectors and other photographic apparatus.

The laboratory is under the general supervision of Garson Meyer, chief chemist at the Camera Works. Meyer holds the designation of "plastics pioneer," awarded by the Society of the Plastics Industry in 1944. Gerard Delaire is engineer-in-charge of the laboratory.

A "plastic parts museum" also is being set up in the laboratory. This collection of hundreds of plastic products—photographic and non-photographic—will aid Camera Works engineers in "studying how the other fellow uses plastics," Meyer said.

Plastics are widely utilized in making cameras, carrying cases, and many other pieces of photographic equipment, from tiny precision gears to relatively large professional apparatus. The actual large scale production of Kodak's plastic parts is done by several custom molding concerns.

The laboratory, however, will enable Kodak to solve more quickly and scientifically many research and engineering problems associated with the use of plastics in photographic equipment.

Before the addition of the plastics laboratory, the Camera Works used part of the plant's chemical laboratory for plastics experiments. Also employed, when possible, were facilities available in the plants of plastics molders.

Among the equipment in the new laboratory are testing devices to measure impact, bending, hardness, stiffness and heat distortion. The laboratory has both injection and compression presses as well as apparatus for casting plastic materials.

---

## NEW FILMS ON TECHNICAL LETTERING

A new series of discussional slidefilms on Technical Lettering—A Unit of Drafting is announced by The Jam Handy Organization. Designed to help teachers of lettering show actual strokes and proportions of letters to students, these films include 235 lighted pictures. The introductory film discusses uses of lettering, characteristics of single-stroke Gothic letters, and similarities between letters. The other four films give instructions for making vertical capitals.

Each of these slidefilms is organized into lessons on groups of letters produced with similar strokes. Questions, review and practice suggestions are included in each film. All letters conform to the recommendations of the American Standards Association. The film titles are: 1—Single-Stroke Gothic—Introduction. 2—Vertical Capitals IHT LEF AVW. 3—Vertical Capitals MN YZX OQCG. 4—Vertical Capitals 069 83S DUJ PRB. 5—Vertical Capitals 725& and Spacing. The price of the complete kit is $18. Single films are $3.75 each, f.o.b. Detroit. For details on these new slidefilms write to The Jam Handy Organization, 2821 East Grand Boulevard, Detroit 11, Michigan or contact the organization's distributor in your area.

---

## EDUCATIONAL CONDITIONS IN THE U.S.A.

Right now, in 1947–48, there are:

—100,000 teachers employed on emergency substandard certificates—one in nine as contrasted with one in 200 in 1939–40.

—large shortages of qualified teachers in many states.

—salary schedules so low in many states that often the ablest high school graduates shun teaching as a career.

—not less than 2,000,000 children denied proper instructional opportunities as a direct result of the teacher shortage.

—overcrowded classrooms and heavy teacher load in every state.

—educational slum areas in many states and communities.

—millions of children denied adequate school buildings, equipment, and instructional supplies.